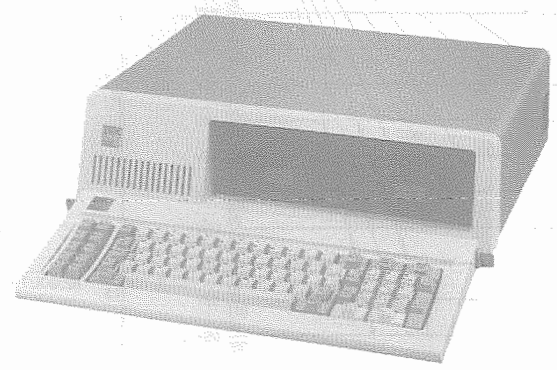


KEYBOARD, SYSTEM BOARD
PRINTER ADAPTER,
POWER SUPPLY



MONOCHROME MONITOR/
PRINTER ADAPTER

See Folder CSCS2-A

COLOR GRAPHIC
MONITOR ADAPTER

See Folder CSCS2-B

DISK DRIVE ADAPTER/
DISK DRIVES (A & B) TYPE 1

See Folder CSCS2-C

SAFETY PRECAUTIONS

See page 44.

PRELIMINARY SERVICE CHECKS

ENCLOSED

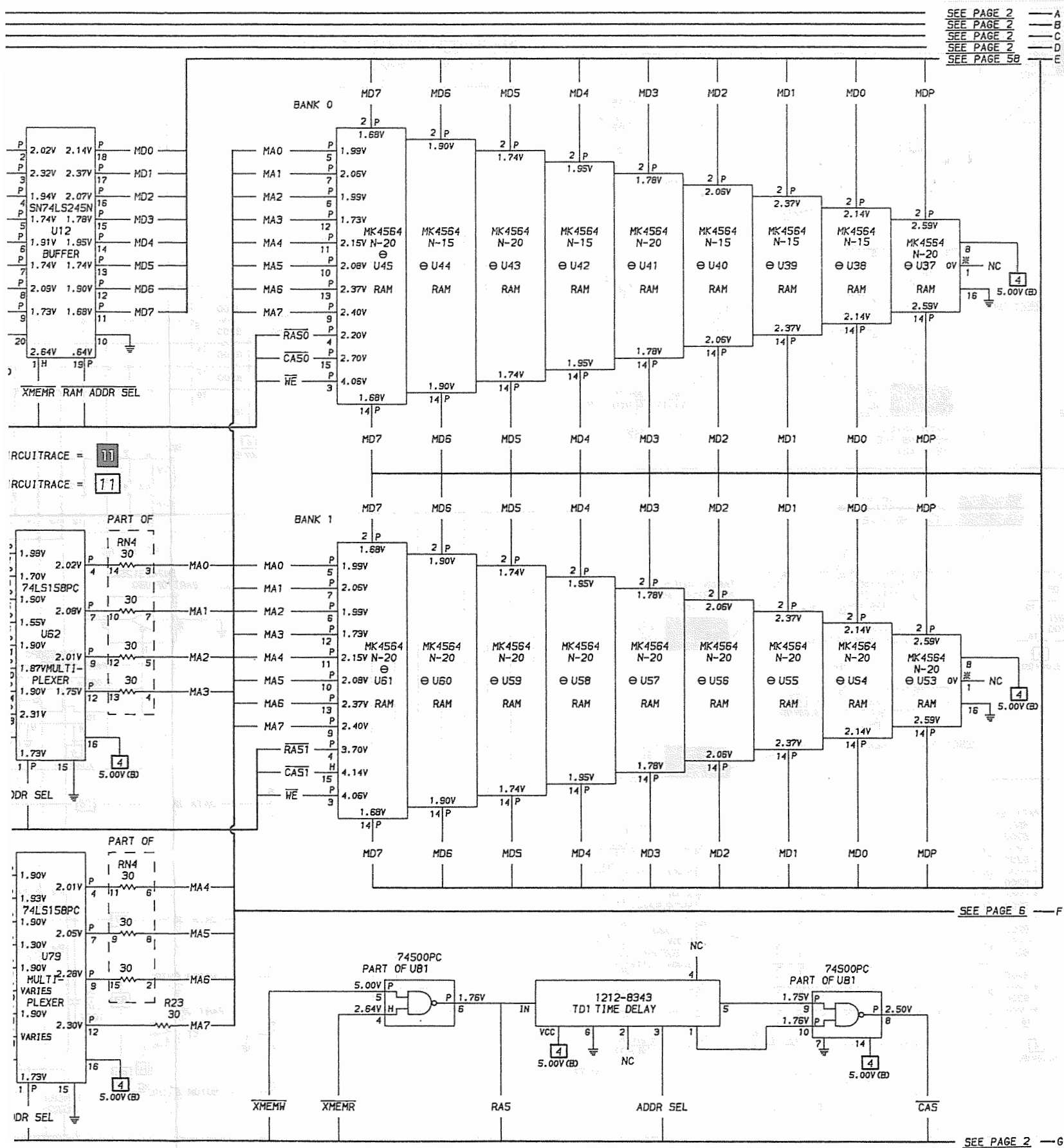
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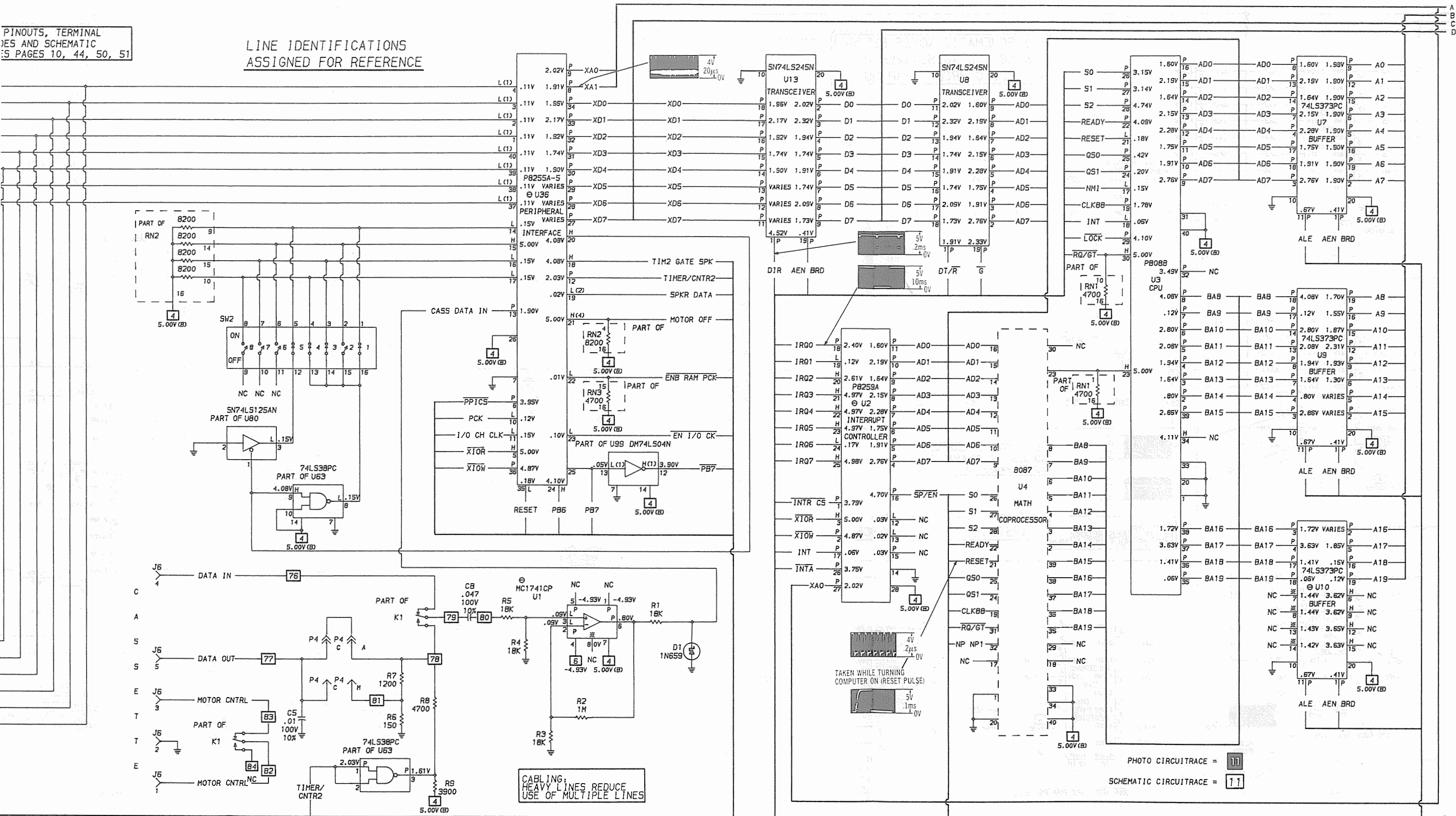
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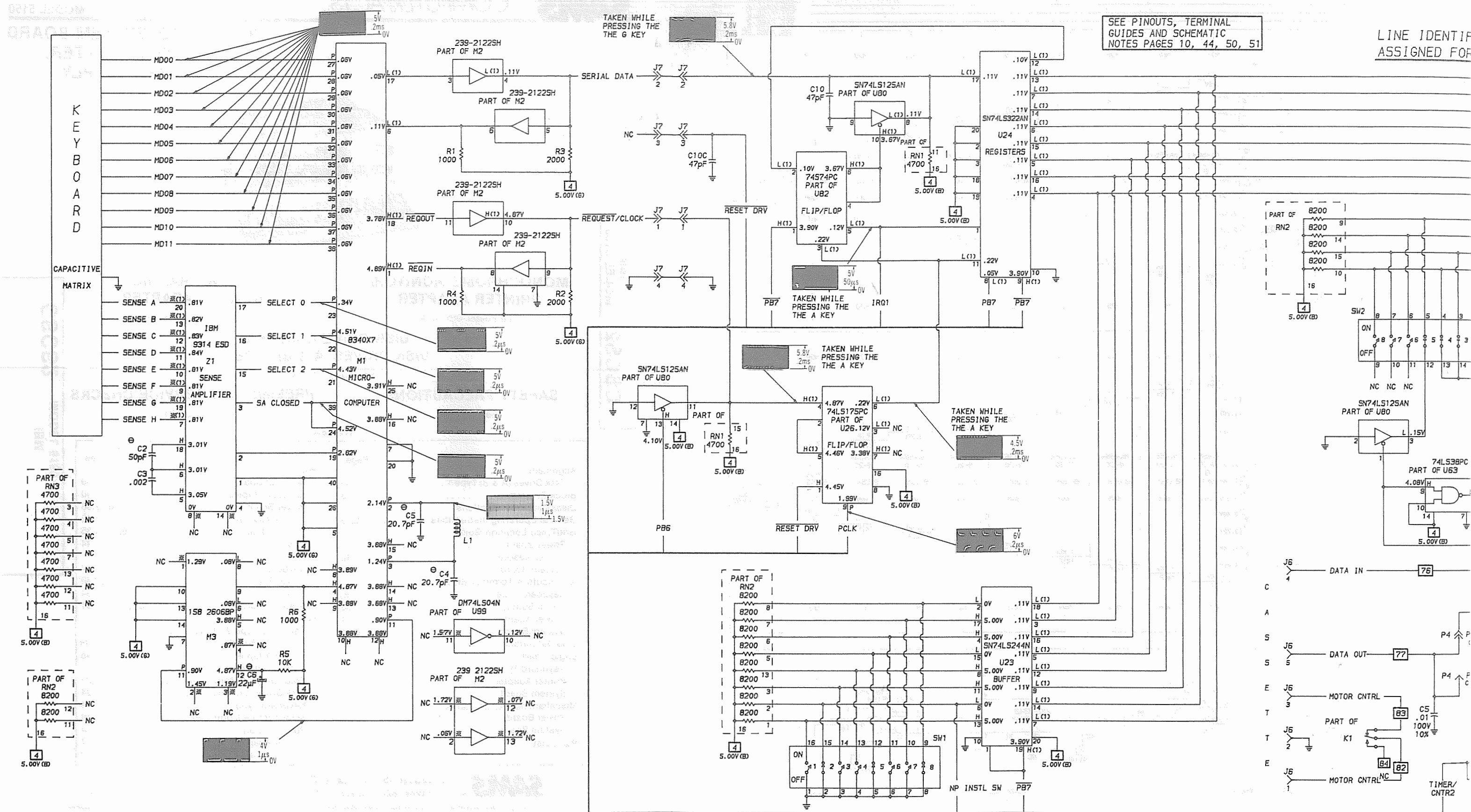
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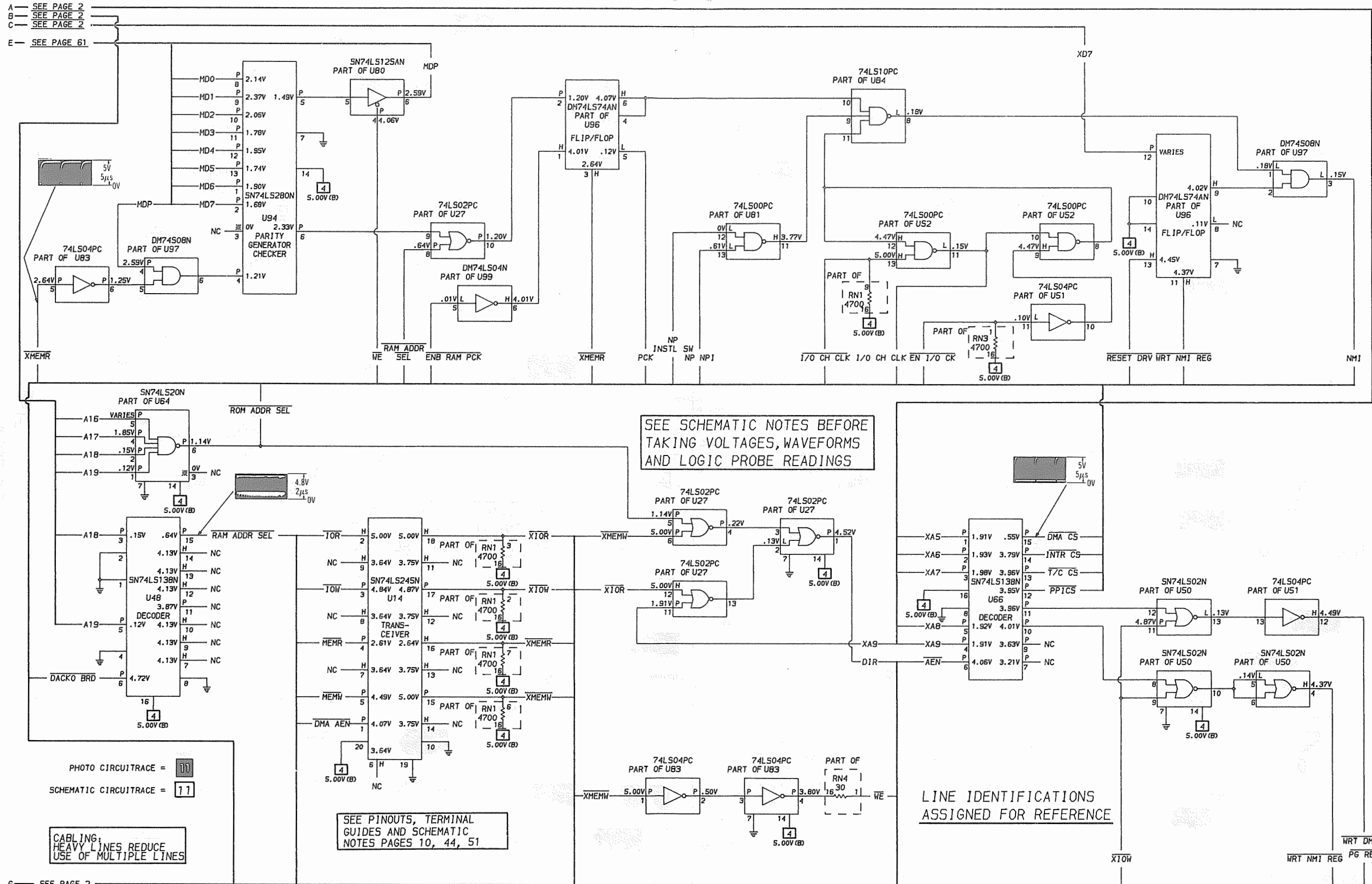
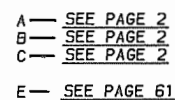


IBM
MODEL 5150
SYSTEM BOARD

LINE IDENTIFICATIONS
ASSIGNED FOR REFERENCE

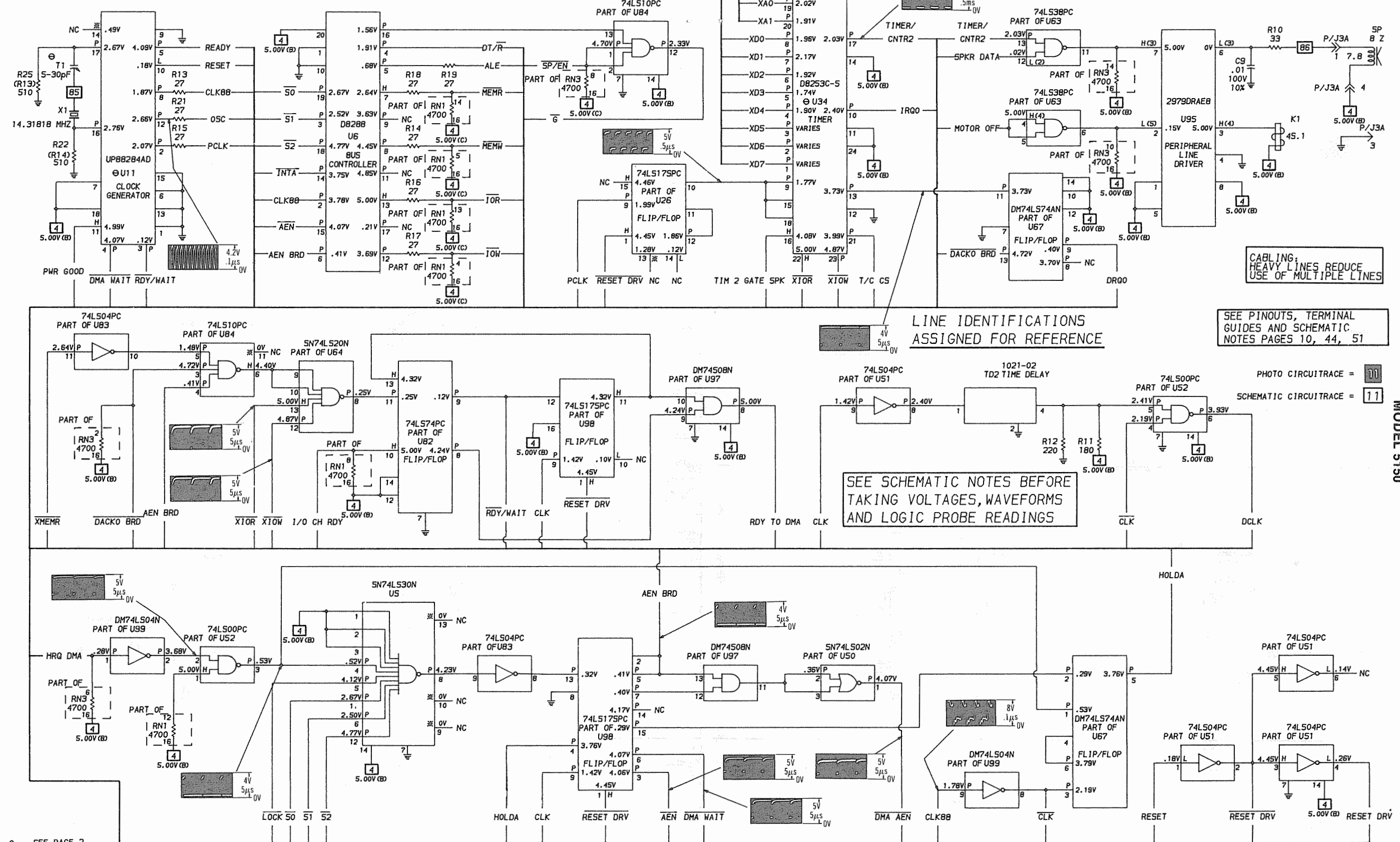






A — SEE PAGE 2

C — SEE PAGE 2

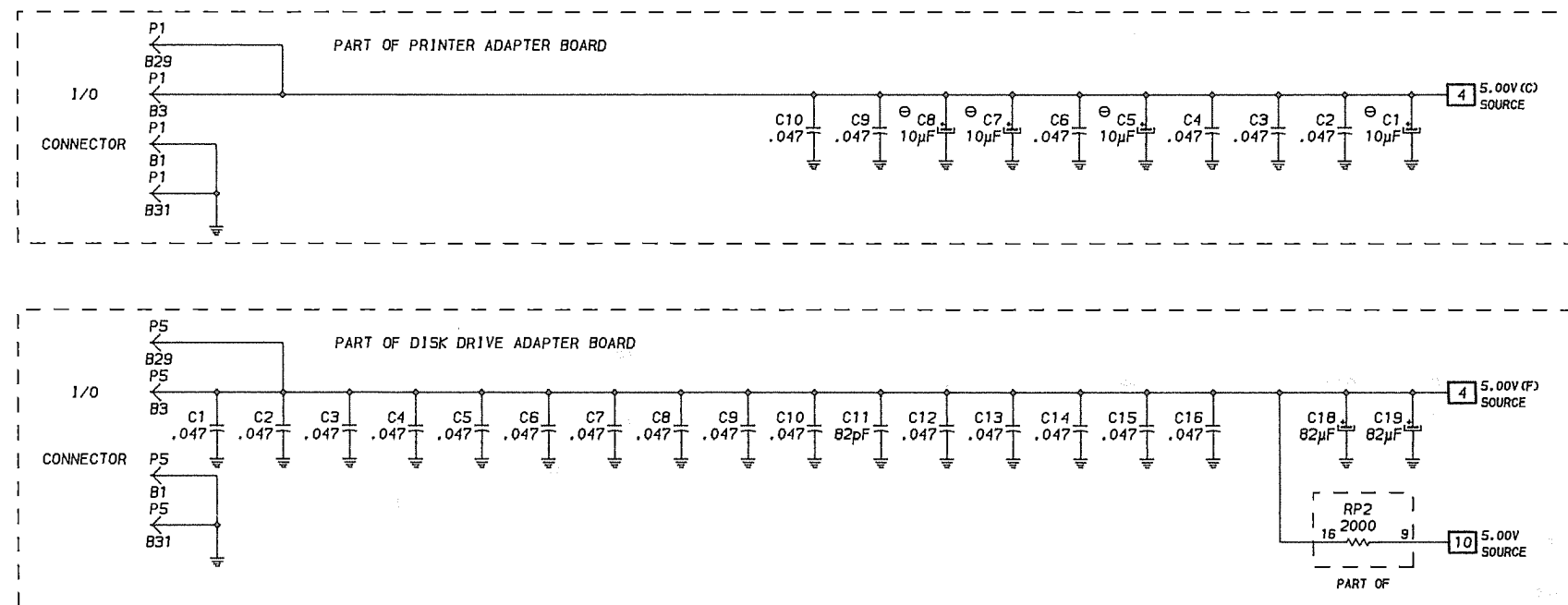
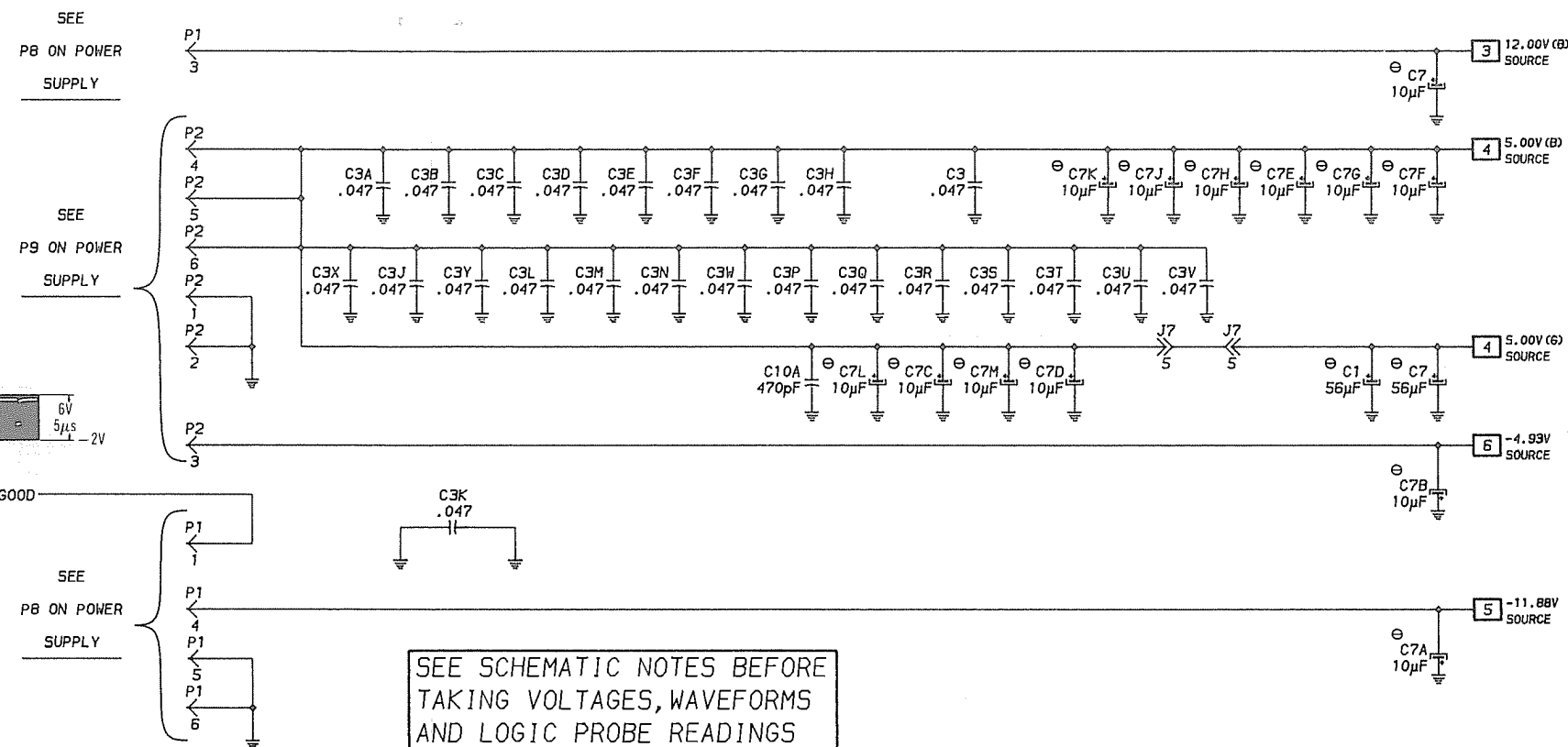
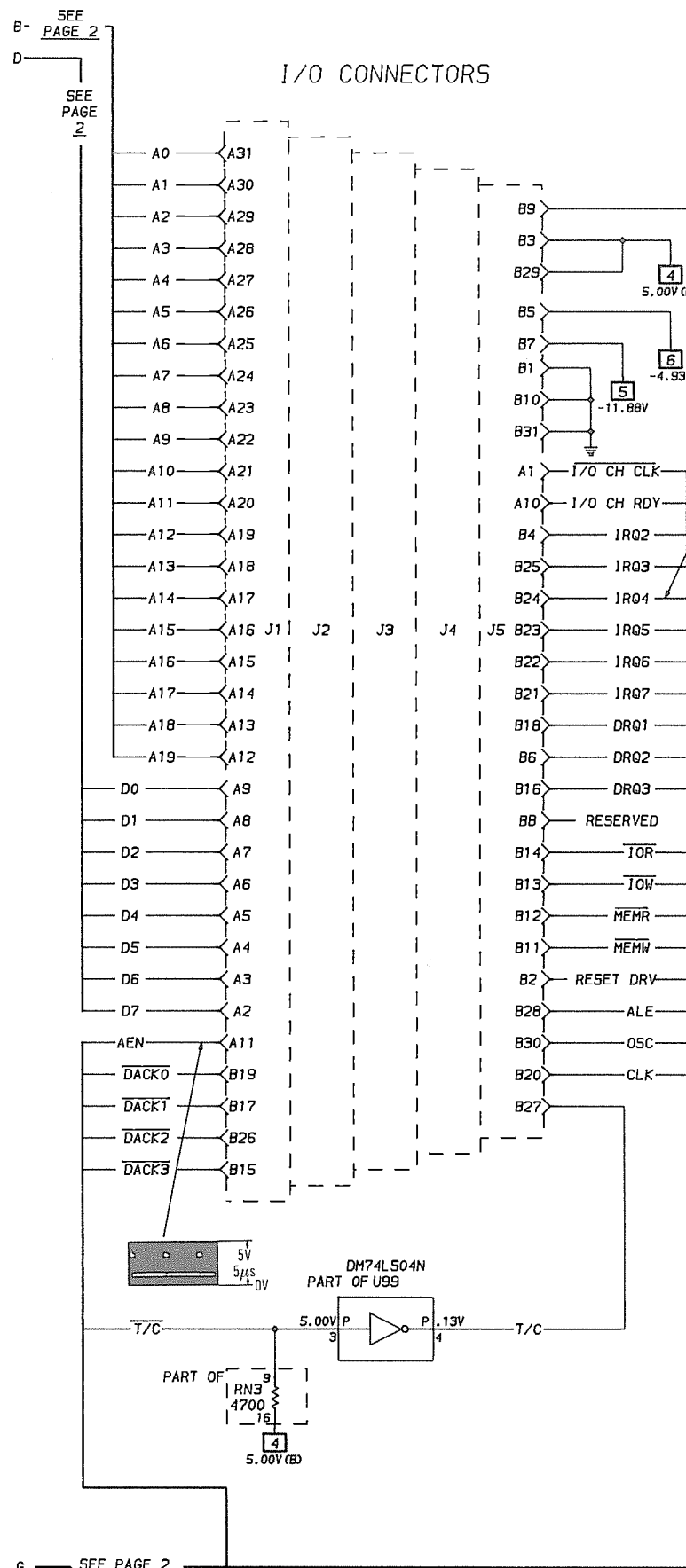


G — SEE PAGE 2

A PHOTOFACT STANDARD NOTATION SCHEMATIC
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SYSTEM BOARD

SYSTEM BOARD



SEE PINOUTS, TERMINAL
GUIDES AND SCHEMATIC
NOTES PAGES 10, 44, 50, 51

CABLING:
HEAVY LINES REDUCE
USE OF MULTIPLE LINES

LINE IDENTIFICATIONS
ASSIGNED FOR REFERENCE

PHOTO CIRCUITRACE = 11
SCHEMATIC CIRCUITRACE = 11

CSCS2
IBM
MODEL 5150

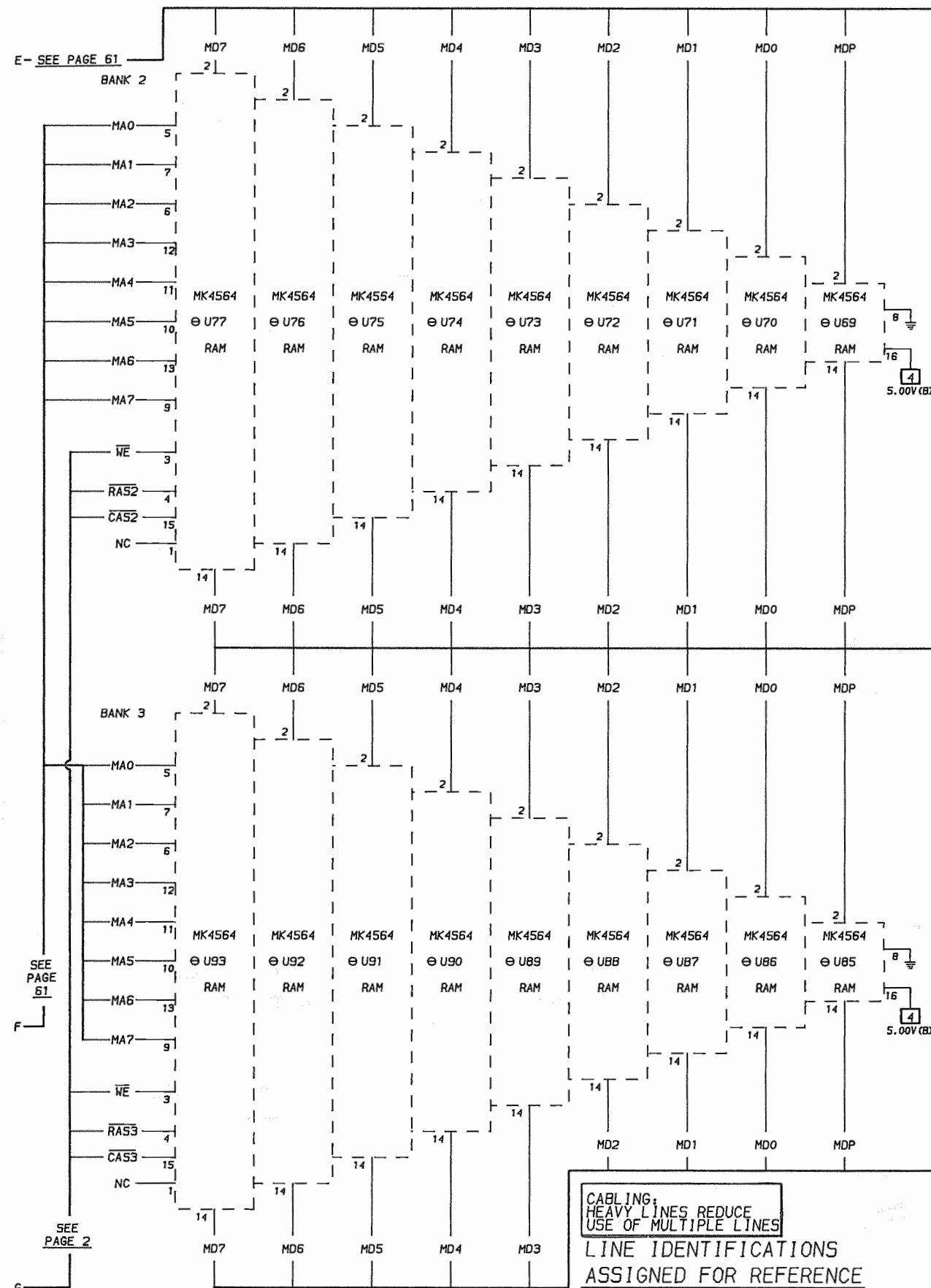
A PHOTOFAC STANDARD NOTATION SCHEMATIC

WITH CIRCUITRACE

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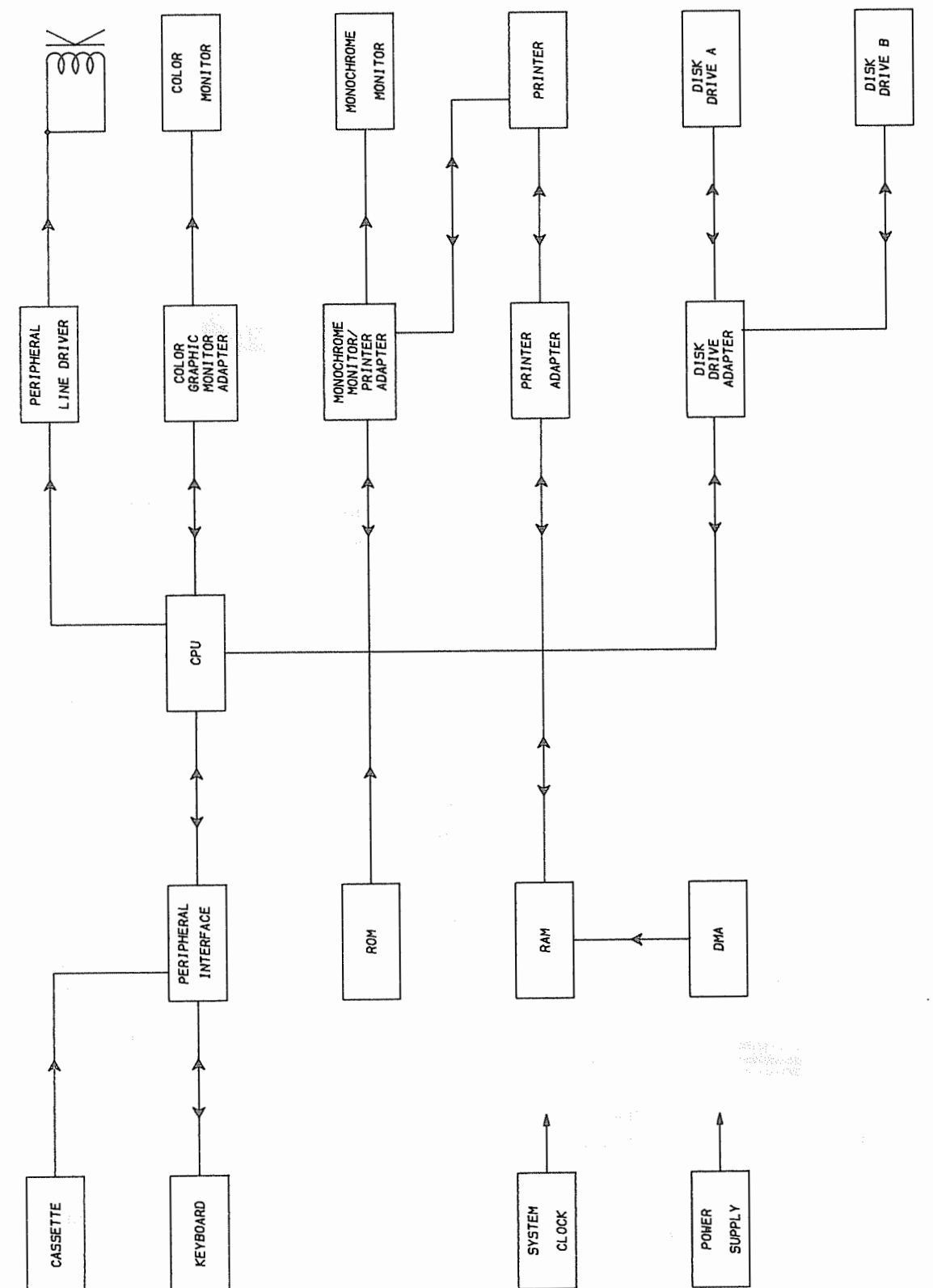
SYSTEM BOARD

SYSTEM BOARD



SYSTEM BOARD

A PHOTOFAC STANDARD NOTATION SCHEMATIC
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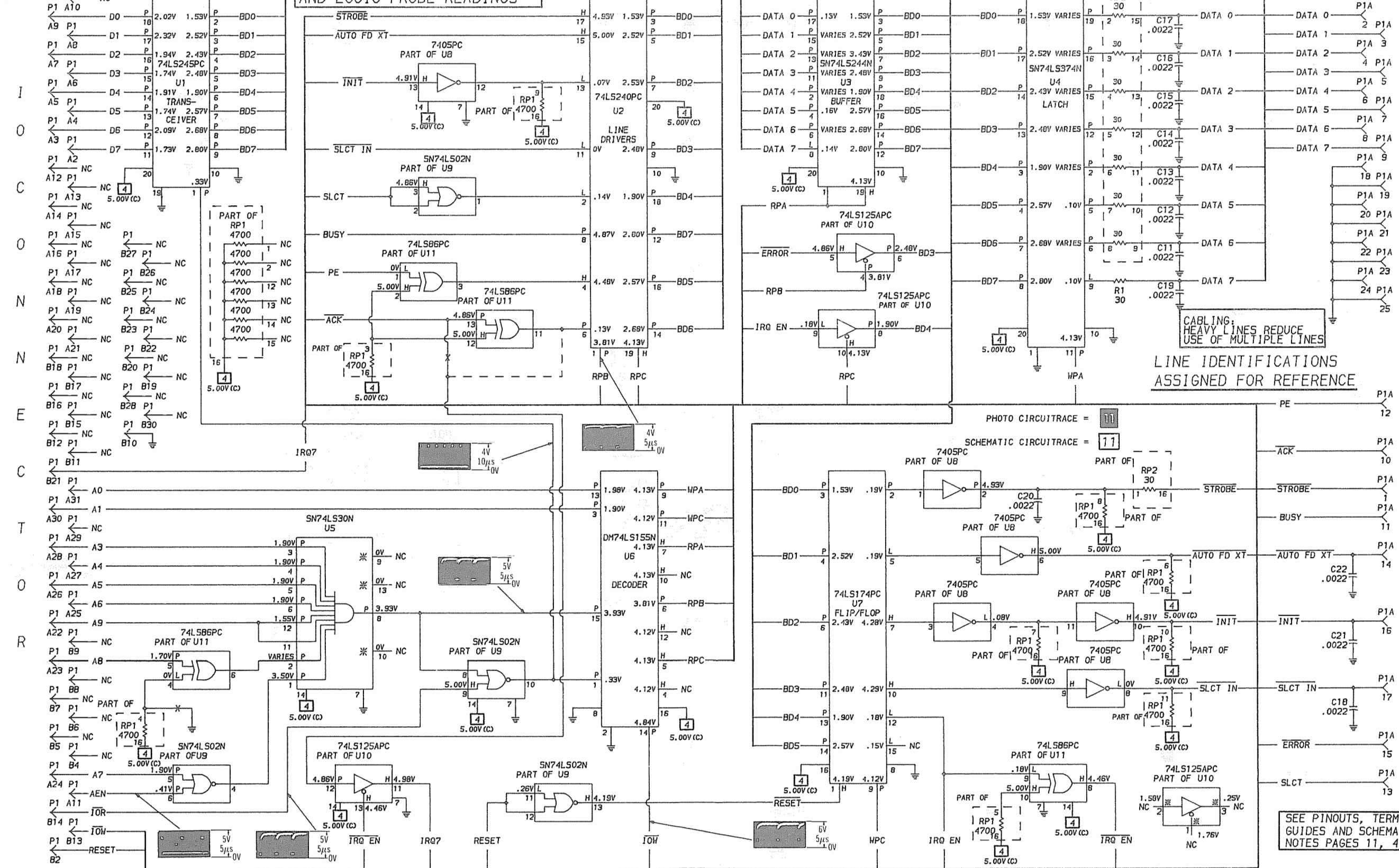


IBM
MODEL 5150

BLOCK DIAGRAM

SEE
J1 ON
SYSTEM
BOARD
PAGE 56

SEE SCHEMATIC NOTES BEFORE
TAKING VOLTAGES, WAVEFORMS
AND LOGIC PROBE READINGS



CABLING:
HEAVY LINES REDUCE
USE OF MULTIPLE LINES

SEE PINOUTS, TERMINAL
GUIDES AND SCHEMATIC
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A PHOTOFAC STANDARD NOTATION SCHEMATIC

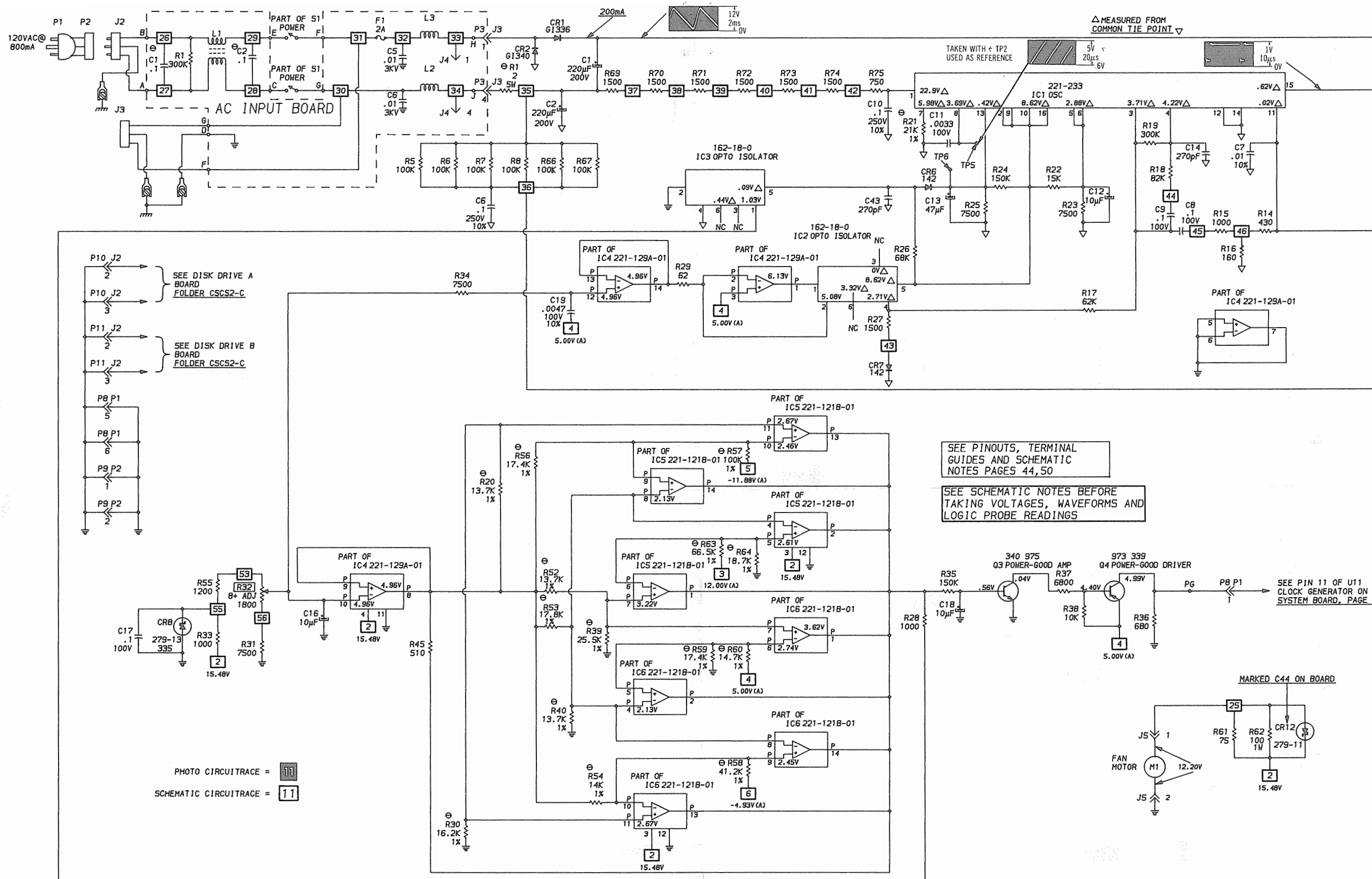
WITH CIRCUITAGE

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PRINTER ADAPTER

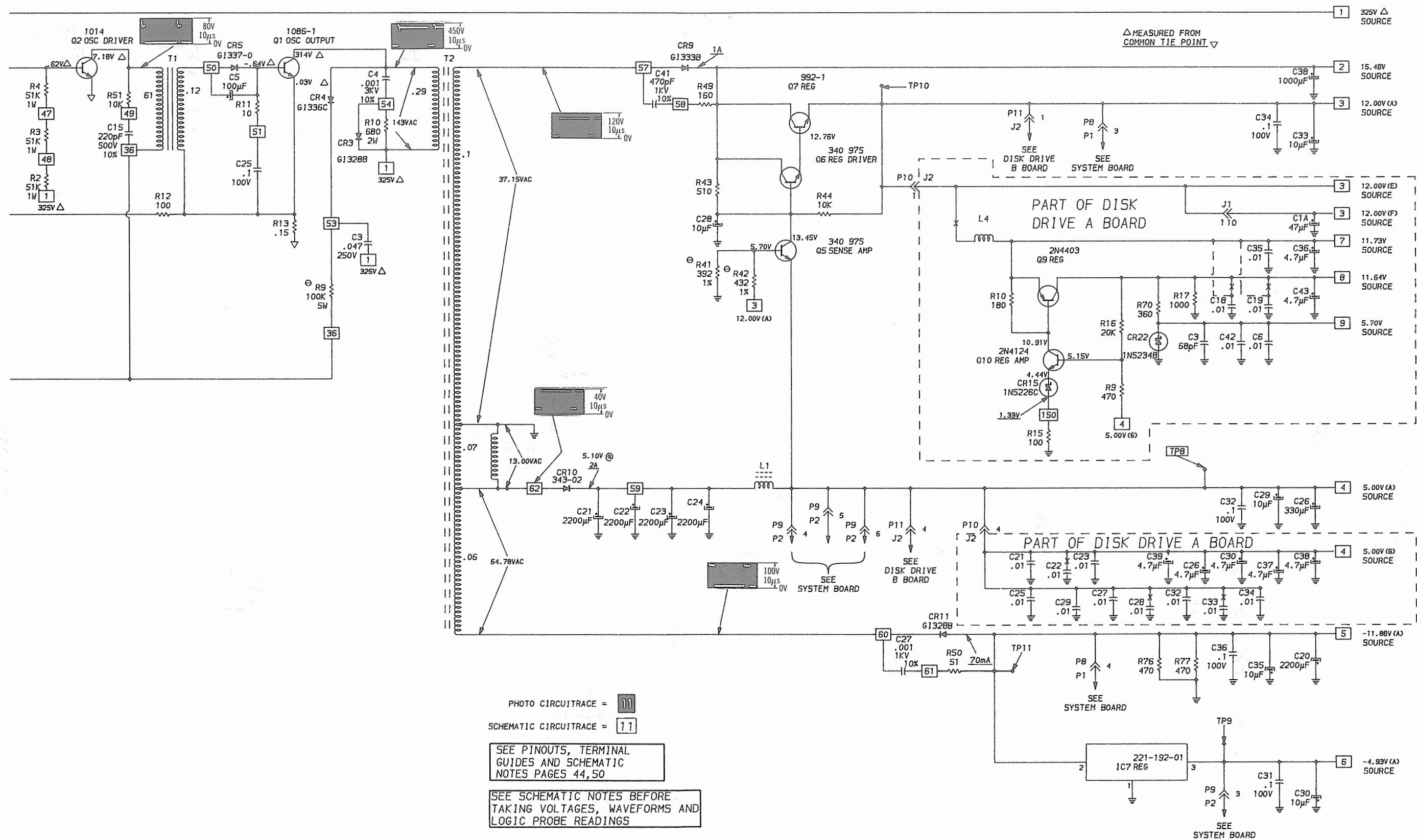
PRINTER ADAPTER

IBM
MODEL 5150

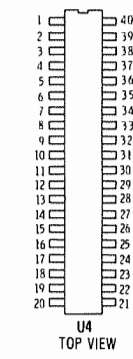
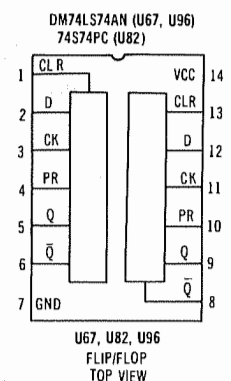
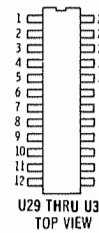
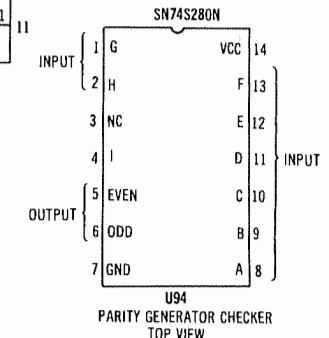
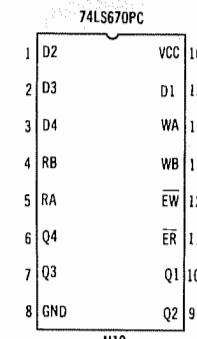
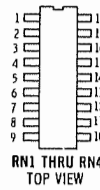
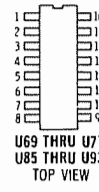
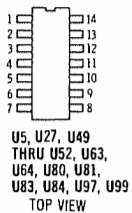
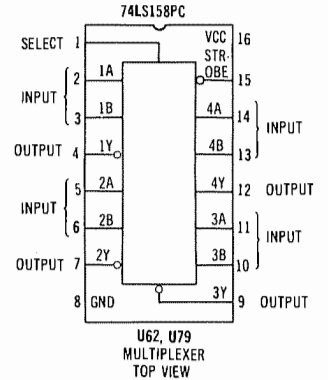
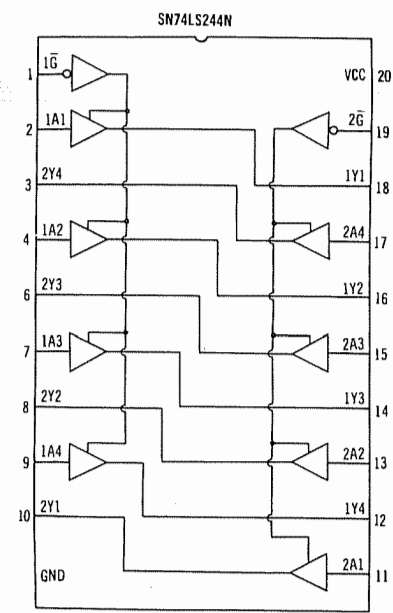
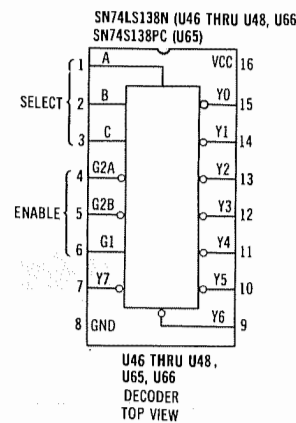
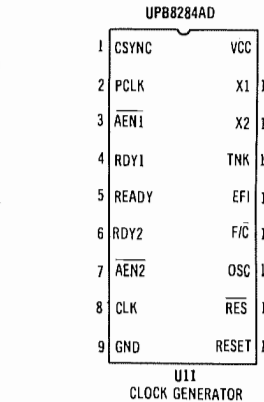
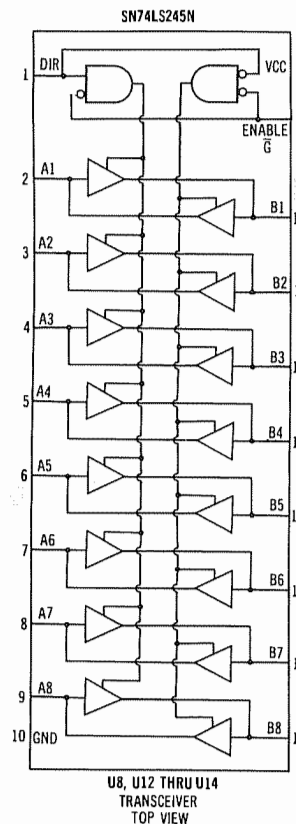
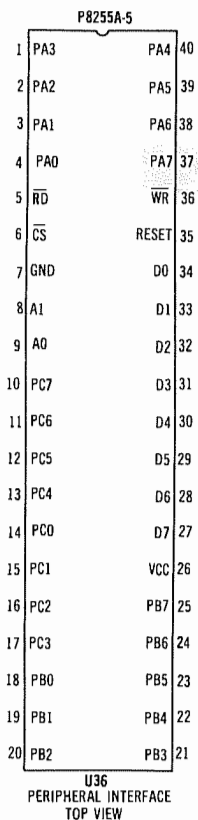
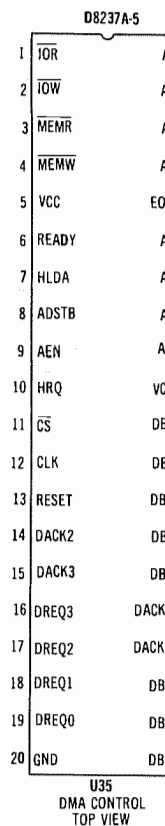
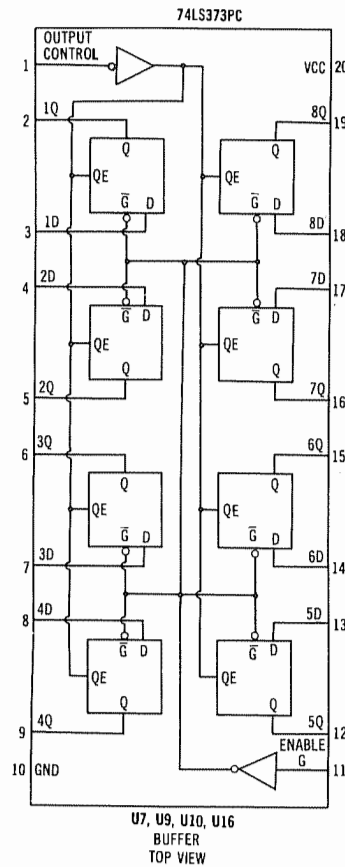
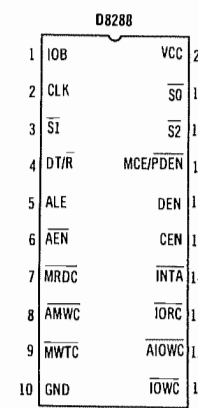
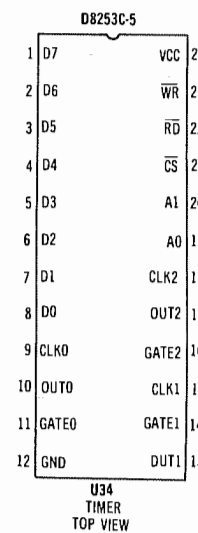
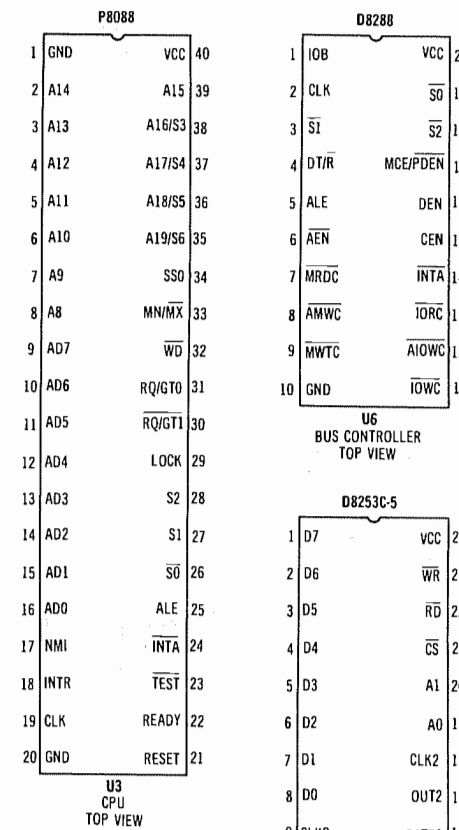
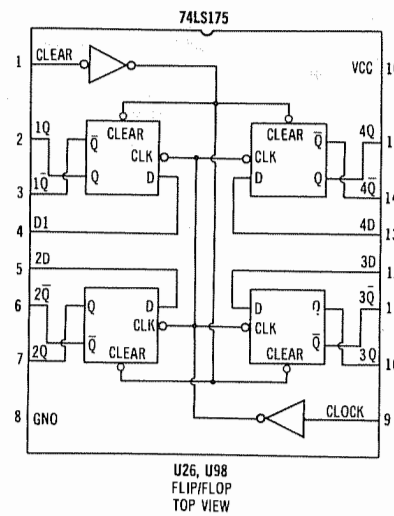
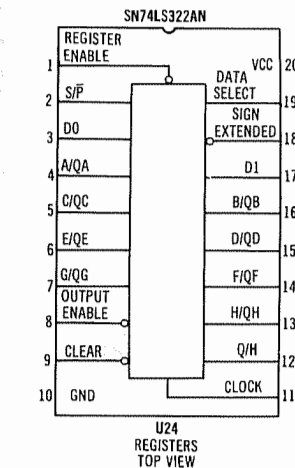
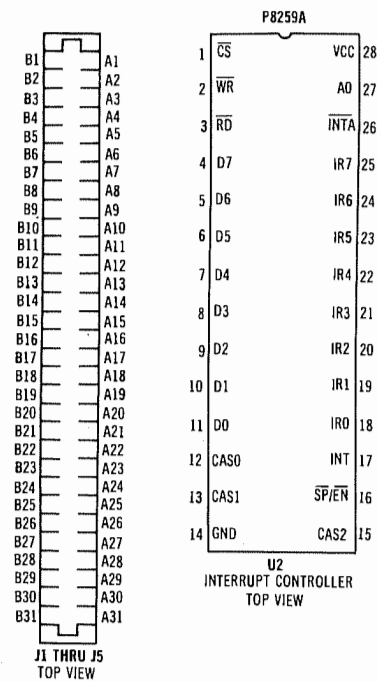


A PHOTOFACIT STANDARD NOTATION SCHEMATIC
WITH **CIRCUITRACE**
© Howard W. Sams & Co., Inc. 1984 **POWER SUPPLY**

POWER SUPPLY



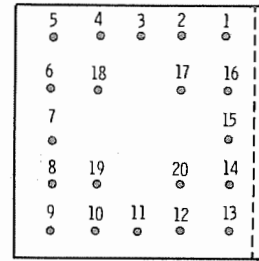
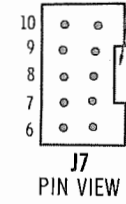
IC PINOUTS & TERMINAL GUIDES



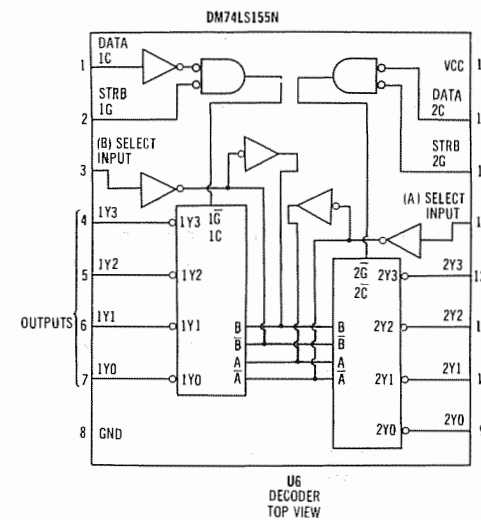
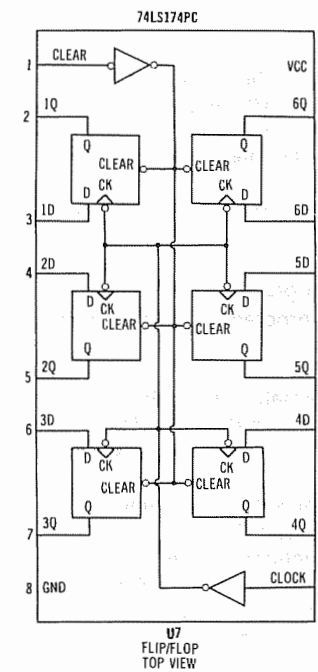
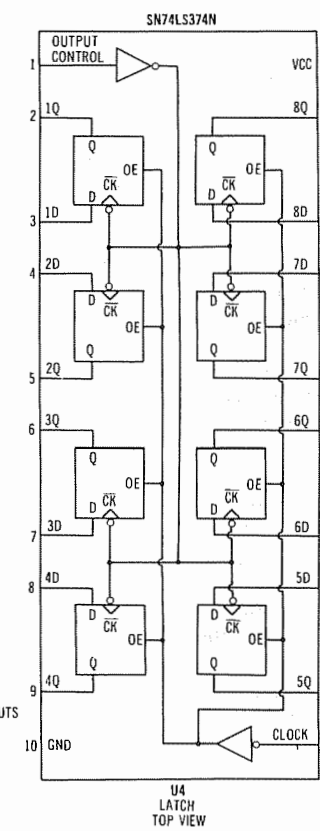
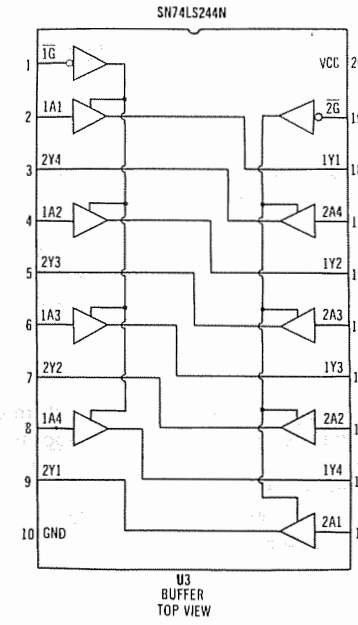
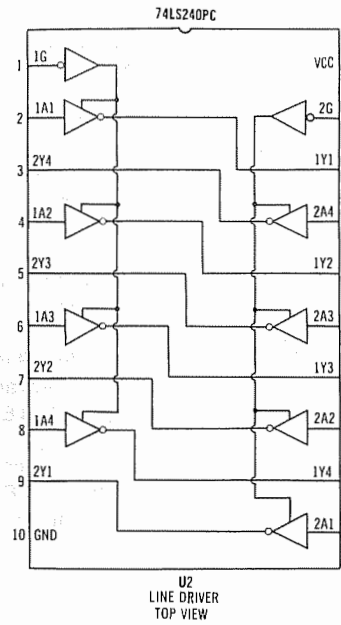
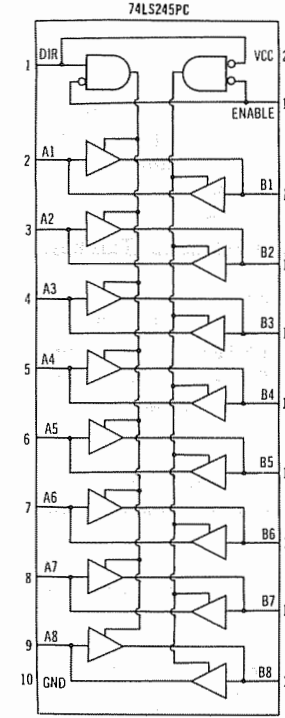
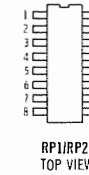
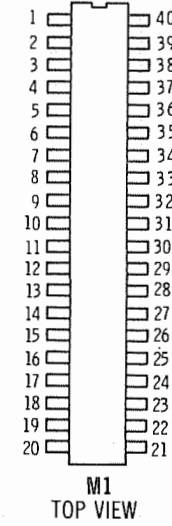
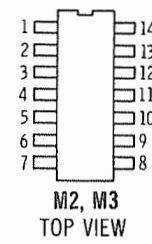
IBM
MODEL 5150

IC PINOUTS & TERMINAL GUIDES

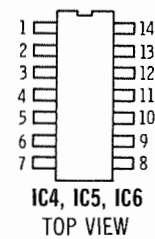
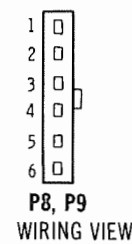
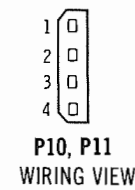
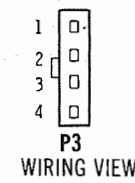
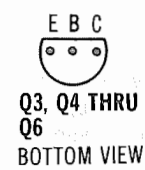
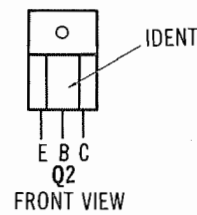
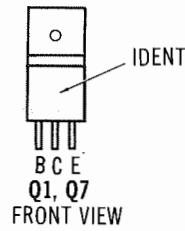
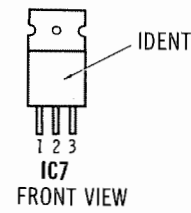
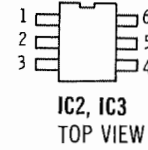
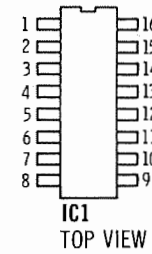
DIP
IN
CASE



BEVELED ON TOP



KEYBOARD TYPE 2



POWER SUPPLY

CSCS2
MODEL 5150

IBM

PRINTER ADAPTER

MISCELLANEOUS ADJUSTMENTS

POWER BOARD

B + ADJUSTMENT

NOTE: The Power Supply **must** be connected to the computer to make this adjustment. Connect a DC voltmeter to pin 8 of IC IC4. Adjust B+ Adjust Control (R32) for 5.00V.

SYSTEM BOARD

COLOR ADJUST

Connect the Input of a frequency counter to pin 12 of the Clock Generator IC (U11). Adjust the Color Adjust Trimmer (T1) for a frequency of 14.31818MHz.

GENERAL OPERATING INSTRUCTIONS

POWER ON TEST

A Power On test is automatically performed each time the Computer is turned On. Several diagnostic tests are performed and if a problem is detected, an error code will be momentarily displayed on the Monitor screen. For an explanation of the various error codes, see the "Computer Self-Test" section of the General Operating Instructions.

BOOT UP

Insert a bootable diskette into Disk Drive A and turn On the Computer. The Computer will automatically boot up using the diskette in Disk Drive A. If a PC DOS (Personal Computer Disk Operating System) diskette is used, the Computer will display the date and time and ask for a new date and time. After the date and time have been entered, the version of DOS will be displayed on the Monitor screen along with an A> which indicates the DOS is running.

PC DOS

For a list of file names on the diskette in the current Disk Drive, type DIR and press the ENTER key. To specify Disk Drive that is not current (default), use DIR A: for Disk Drive A or DIR B: for Disk Drive B.

To return to PC DOS from Basic, type SYSTEM and press the ENTER key.

To load a (System) program from a diskette while in DOS, type the program name and press the ENTER key.

A blank diskette must be formatted before it can be used to save information which is in memory. A formatted diskette must contain a DOS or a Start-up program before the Computer will boot up using that diskette.

Insert a diskette containing a "Format Program" into Disk Drive A. Type FORMAT and press the ENTER key. Follow the instructions on the Monitor screen to format the unformatted diskette. NOTE: Formatting a diskette will wipe out any programs previously placed on the diskette. The Computer automatically defaults to Disk Drive A if the destination Disk Drive is not specified. Be sure to specify the destination Disk Drive of the diskette to be formatted or the original diskette may be ruined by the default action.

BASIC

When turned On, the Computer will come up in Cassette (ROM) Basic if there is not a bootable DOS diskette in Disk

Drive A. The version of Basic and memory available will appear at the top of the screen. For additional information on Cassette I/O operations see the "Cassette Operation" section of the General Operating Instructions.

The manufacturer also supplies Disk Basic as well as Advanced Disk Basic on diskette. To load either Disk Basic, first boot up DOS. Insert a diskette with Disk Basic or Advanced Disk Basic program on it. Type BASIC and press the RETURN key to load disk Basic or type BASICA and press the ENTER key to load Advanced Disk Basic. to return to DOS from Basic, type SYSTEM and press the ENTER key.

To view a list and the names of programs on a diskette in the current Drive, type FILES and press the ENTER key. Type FILES "B: *.*" and press the ENTER key to list programs from Disk Drive B. Type FILES "A: *.*" to list programs from Disk Drive A if it is not the current (default) drive.

To load a program in Disk Basic or Advanced Disk Basic from the diskette, type LOAD, the program name enclosed in quotes, and press the ENTER key.

To save a program, type SAVE, the program name enclosed in quotes and press the ENTER key.

To run a program from any Basic mode, type RUN and press the ENTER key. To stop a program, press the CTRL and BREAK (SCROLL LOCK) keys at the same time. NOTE: Some programs will disable or not recognize the CTRL and BREAK keys to prevent the user stopping the program while it is running.

RESETTING COMPUTER

Press the CTRL, ALT, and DEL keys, all three at the same time, to reset the Computer.

CASSETTE OPERATION

To load a program from tape while in Cassette (ROM) Basic, type LOAD, the program name enclosed in quotes and press the ENTER key.

To save a program, type SAVE, the program name enclosed in quotes and press the ENTER key.

To load or save a program from and to tape while in any Disk Basic, type LOAD or SAVE. Then, enclosed in quotes, type CAS1: and the program name, and press the ENTER key. Example: SAVE "CAS1: program name"

SYSTEM BOARD LOGIC (Continued)

PIN NO.	IC U53	IC U54	IC U55	IC U56	IC U57	IC U58	IC U59	IC U60	IC U61	IC U62	IC U63	IC U64	IC U65	IC U66	IC U67
1	*	*	*	*	*	*	*	*	*	P	P	P	P	P	P
2	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
3	P	P	P	P	P	P	P	P	P	P	P	*	H	P	P
4	P	P	P	P	P	P	P	P	P	P	H(4)	P	P	P	P
5	P	P	P	P	P	P	P	P	P	P	H(4)	P	P	P	P
6	P	P	P	P	P	P	P	P	P	P	L(5)	P	P	P	P
7	P	P	P	P	P	P	P	P	P	P	L	L	H	P	L
8	H	H	H	H	H	H	H	H	H	L	L	L	L	L	L
9	P	P	P	P	P	P	P	P	P	P	H	H	H	P	P
10	P	P	P	P	P	P	P	P	P	P	H	H	H	P	H
11	P	P	P	P	P	P	P	P	P	P	H(3)	*	P	P	P
12	P	P	P	P	P	P	P	P	P	P	L(2)	P	H	P	H
13	P	P	P	P	P	P	P	P	P	P	P	H	H	P	P
14	P	P	P	P	P	P	P	P	P	P	H	H	H	P	H
15	P	P	P	P	P	P	P	P	P	L			H	P	
16	L	L	L	L	L	L	L	L	L	H			H	H	
PIN NO.	IC U79	IC U80	IC U81	IC U82	IC U83	IC U84	IC U94	IC U95	IC U96	IC U97	IC U98	IC U99			
1	P	H	P	H(1)	P	P	P	H	H	L	H	P			
2	P	L	P	L(1)	P	P	P	L(2)	P	H	P	P			
3	P	L	P	L(1)	P	P	*	H(4)	P	L	P	P			
4	P	P	H	H(1)	P	P	P	L	H	P	P	P			
5	P	P	P	L(1)	P	P	P	H	L	P	P	L			
6	P	P	P	H(1)	P	H	P	L(3)	H	P	P	H			
7	P	L	L	L	L	L	L	H(3)	L	L	P	L			
8	L	L(1)	P	P	P	L	P	H	L	P	L	L			
9	P	L	P	P	P	H	P		H	P	P	L			
10	P	H(1)	P	H	P	H	P		H	H	L	*			
11	P	H(1)	H	P	H	H	P		H	P	H	H			
12	P	L	L	H	P	P	P		P	P	P	H(1)			
13	P	H	L	H	P	P	P		H	P	P	L(1)			
14	P	H	H	H	H	H	H		H	H	P	H			
15	L										P				
16	H										H				

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Logic Probe Display

L = Low

H = High

P = Pulse

* = Open (No light On)

(1) Probe indicates P when a key is pressed.

(2) Probe indicates H when speakers sounds.

(3) Probe indicates P while beeping speaker.

(4) Probe indicates L when cassette motor turns On.

(5) Probe indicates H when cassette motor turns Off.

SYSTEM BOARD LOGIC (Continued)

PIN NO.	IC U30	IC U31	IC U32	IC U33	IC U34	PIN NO.	IC U35	PIN NO.	IC U35	PIN NO.	IC U36	PIN NO.	IC U36	PIN NO.	IC U37
1	P	P	P	P	P	1	H	21	P	1	L(1)	21	H(4)	1	*
2	P	P	P	P	P	2	P	22	P	2	L(1)	22	L	2	P
3	P	P	P	P	P	3	H	23	P	3	L(1)	23	L	3	P
4	P	P	P	P	P	4	P	24	H	4	L(1)	24	H	4	P
5	P	P	P	P	P	5	H	25	P	5	H	25	L(1)	5	P
6	P	P	P	P	P	6	P	26	P	6	P	26	H	6	P
7	P	P	P	P	P	7	P	27	P	7	L	27	P	7	P
8	P	P	P	P	P	8	P	28	P	8	P	28	P	8	H
9	P	P	P	P	P	9	P	29	P	9	P	29	P	9	P
10	P	P	P	P	P	10	P	30	P	10	L	30	P	10	P
11	P	P	P	P	H	11	P	31	H	11	L	31	P	11	P
12	L	L	L	L	L	12	P	32	P	12	P	32	P	12	P
13	P	P	P	P	P	13	L	33	P	13	P	33	P	13	P
14	P	P	P	P	H	14	H	34	P	14	L	34	P	14	P
15	P	P	P	P	P	15	H	35	P	15	H	35	L	15	P
16	P	P	P	P	H	16	*	36	P	16	L	36	P	16	L
17	P	P	P	P	P	17	L	37	P	17	L	37	L(1)		
18	P	P	P	P	P	18	*	38	P	18	H	38	L(1)		
19	P	P	P	P	P	19	P	39	P	19	L(2)	39	L(1)		
20	H	P	H	P	P	20	L	40	P	20	H	40	L(1)		
21	P	P	P	P	P										
22	P	P	P	P	H										
23	P	P	P	P	P										
24	H	H	H	H	H										

PIN NO.	IC U38	IC U39	IC U40	IC U41	IC U42	IC U43	IC U44	IC U45	IC U46	IC U47	IC U48	IC U49	IC U50	IC U51	IC U52
1	*	*	*	*	*	*	*	*	P	P	L	H	P	L	H
2	P	P	P	P	P	P	P	P	P	P	L	P	P	H	P
3	P	P	P	P	P	P	P	P	P	P	L	P	P	H	P
4	P	P	P	P	P	P	P	P	P	P	L	P	P	H	P
5	P	P	P	P	P	P	P	P	P	P	P	P	L	H	P
6	P	P	P	P	P	P	P	P	P	P	P	P	L	H	P
7	P	P	P	P	P	P	P	P	P	P	H	L	L	L	P
8	H	H	H	H	H	H	H	H	L	L	L	P	L	L	H
9	P	P	P	P	P	P	P	P	H	H	H	P	P	P	H
10	P	P	P	P	P	P	P	P	P	H	H	P	L	H	L
11	P	P	P	P	P	P	P	P	P	H	H	P	P	L	L
12	P	P	P	P	P	P	P	P	P	H	H	P	P	L	H
13	P	P	P	P	P	P	P	P	H	H	H	P	L	H	H
14	P	P	P	P	P	P	P	P	H	H	H	P	L	H	H
15	P	P	P	P	P	P	P	P	H	H	H	P	L	H	H
16	L	L	L	L	L	L	L	L	H	H	H				

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No light On)
(1) Probe indicates P when a key is pressed.
(4) Probe indicates L when cassette motor turns On.

GENERAL OPERATING INSTRUCTIONS (Continued)

COMPUTER SELF-TEST		ERROR CODE	AREA OF PROBLEM
The Computer performs a self-test every time it is turned On. If no problems are detected, the Computer will beep once and (if there is no diskette in the Disk Drive) come up in Cassette (ROM) Basic.		02X	Power Supply
		1XX	System Board
		20X or XX20X or XXXX	Memory
		30X or XX30X	Keyboard
If a problem is detected various audio beeps may occur and/or an error code number may appear on the Monitor screen. Use the following charts to determine the area of the problem.		4XX	Monochrome Monitor/Printer Adapter
		5XX	Color Graphic Monitor Adapter
		6XX	Disk Drive
		7XX	Math Coprocessor
AUDIO		9XX	Printer Adapter
		11XX	Asynchronous Communication (RS232C)
		12XX	Alternate Asynchronous Communication
		13XX	Game Controller Adapter
No beep or display. Beeps continuously. Repeated short beeps. One long and one short beep One long and two short beeps		14XX	Printer Adapter
		15XX	Synchronous Data Link Control (SDLC) Communication Adapter
		17XX	Hard (Fixed) Disk Drive
		18XX	Expansion Unit
One short beep and improper or blank display.		20XX	Binary Synchronous Communications (BSC) Adapter
		21XX	Alternate BSC Adapter
One short beep and Basic statement on Monitor screen, with bootable diskette in Disk Drive and door closed.			

X = Any number

NOTE: The device tested good if the last two digits of the error code are zeros.

DISASSEMBLY INSTRUCTIONS

MAIN SYSTEM UNIT

Remove five screws from rear of cabinet. Slide cabinet forward and remove from unit.

POWER SUPPLY REMOVAL

Disconnect Connectors P8 and P9 from System Board and connectors P10 and P11 from Disk Drives. Remove four screws from rear of the Power Supply cabinet. Push Power Supply forward about 1/2 inch to clear mounting tabs on cabinet bottom and lift Power Supply from unit.

DISK DRIVE REMOVAL

Disconnect two Disk Drive Adapter connectors, one from the rear of each Disk Drive. Disconnect Power Supply Connectors P10 and P11 from the rear of the Disk Drives. Remove two screws from the side of Disk Drive A and slide Disk Drive out the front of cabinet.

SYSTEM BOARD REMOVAL

Remove all Adapter boards from expansion slots. Disconnect Disk Drive connectors and Power Supply connectors from System Board. Disconnect speaker connectors. Remove two screws holding System Board to cabinet bottom. Slide System Board to the left to release plastic stand-offs from mounting slots on cabinet bottom. Lift system board from unit.

KEYBOARD

Lay Keyboard facedown and remove two screws holding lower case. Lift lower case up and out of front retaining slots. Keyboard assembly may now be removed from upper case. NOTE: Do Not attempt to disassemble Keyboard switch assembly. The key caps may be removed one at a time, by lifting up on the cap from the top of the Keyboard.

CSGS2
MODEL 5150
IBM

TROUBLESHOOTING

POWER SUPPLY

POWER SUPPLY (SHUTDOWN)

NOTE: Make sure the power is Off before disconnecting plugs and boards. The power supply has an automatic shutdown feature to shutdown the power supply whenever an overload or overvoltage condition occurs. All the source voltages will drop to 0V when shutdown occurs. To determine whether the System Board or a Disk Drive is causing the power supply to shutdown, or if the shutdown is caused by the power supply itself, disconnect Plugs P8 and P9, which go to the System Board, and Plugs P10 and P11, which go to the Disk Drives. Connect a 47 Ohm, 1 Watt, resistor between pins 2 and 4 of Plug P10. Apply power and check for 5V at pin 1, - 12V at pin 4 and 12V at pin 3 of Plug P8. If the source voltages are not correct, the problem is in the power supply.

If the power supply is normal, remove power and plug in the System Board, Adapters and the Disk Drives. Plug in these boards one at a time, checking the source voltage after each is plugged in, to determine which board or Disk Drive is causing the shutdown.

The power supply also produces a PWR GOOD signal (5V) at pin 1 of Plug P1 which will go low if the source voltages drop too low for the computer to continue processing. The PWR GOOD signal disables the clock at pin 8 of the Clock-Generator IC (U11) when it goes low. If the PWR GOOD signal is low and the source voltages are normal, check the voltages and components associated with Power-Good Driver Transistors (Q3 and Q4). When shutdown occurs all the voltages on IC4, IC5 and IC6 will drop to 0V and the voltage at TP6 (pin 13 of IC1) will go up to about 1.00V. The waveform at TP5 (pin 8 of IC1) should stay the same in shutdown.

Use a scope to check for excessive AC ripple and noise at TP8, TP9, TP10 and TP11. If the ripple is excessive, check

KEYBOARD TYPE 2

KEYBOARD

Keyboard does not function. Check the Keyboard Connector (J7) for good connections. If the connections are good, check the waveforms at pins 1 and 2 of Connector J7 while pressing the G key on the keyboard. If either waveform is missing, check for that same waveform at the cable plug connector on the keyboard. If the waveform is present, check the cable for open wires. If the waveform shown for pin 1 of Connector J7 is missing at the Keyboard Plug, check for the same waveform at pin 18 of Microcomputer IC (M1). If the waveform is present, check resistor R2 and check IC M2 by substitution. If the waveform shown for pin 2 of Connector J7 is missing at the Keyboard Plug, check for the same waveform at pin 17 of IC M1. If the waveform is present, check Resistor R3 and check IC M2 by substitution. When both waveforms are missing at IC M1, check the waveform at pin 11 of IC M1. If the waveform is missing, check Capacitor C6, Resistors R5 and R6 and check IC M3 by substitution. If the waveform is good, check the waveform at pin 2 of IC M1 and if missing, check Capacitors

the condition of the electrolytic filter capacitors.

POWER SUPPLY

Check the AC Fuse (F1). If the fuse is open, check for a short at cathode of Diode CR1. Also check the voltages, waveforms, and components associated with Oscillator IC (IC1), Oscillator Output Transistor (Q1) and Oscillator Driver Transistor (Q2).

Disconnect power supply plugs P8 and P9 from System Board. Check for 5V at pin 1 of Plug P8. If the 5V is missing, check the voltages and components associated with Power-Good Transistor (Q4).

Check for 12V at pin 3 of Plug P8. If the 12V is missing, check the voltages and components associated with Sense Amp Transistor (Q5), Reg Driver Transistor (Q6), and Reg Transistor (Q7).

Check for 15V at the cathode of Diode CR9 and check condition of Diode CR9.

Check for - 12V at pin 4 of Plug P8. If the - 12V is missing, check Diode CR11 and associated components.

Check for - 5V at pin 3 of Plug P9. If the - 5V is missing, check the voltages and components associated with pins 1 thru 3 of Reg IC (IC7).

Check for 5V at pins 4, 5, and 6 of Plug P9. If the 5V is missing, check the voltages and components associated with Transistor Q5. Check the adjustment of B+ Adjust (R32), see "Miscellaneous Adjustments". If the adjustment does not work, check the voltages and components associated with IC4, IC5 and IC6.

C4 and C5, Coil L1 and check IC M1 by substitution. If the waveform is good, check IC M1 and IC Z1 by substitution.

If the waveforms at pins 1 and 2 of Connector J7 are good, check the waveform at pin 6 of Flip/Flop IC (U26) while pressing any key. If the waveform is missing, check the waveform at pin 9 of IC U26 and check for a high logic reading at pin 1 of IC U26. If the waveform is good and the logic reading is high, check IC U26 by substitution. If the waveform at pin 6 of IC U26 is good, check the waveform at pin 5 of Flip/Flop IC (U82) while pressing any key on the keyboard. If the waveform is missing, check IC U82 by substitution. If the waveform is normal, check the Keyboard Latch IC (U24) and the I/O Port IC (U36) by substitution.

A reset pulse is produced from pin 25 of IC U36 to reset pin 9 of Keyboard Latch IC (U24) after a key is read. Check for a pulse at pins 12 and 13 of IC U99 each time a key is pressed. If the pulse is missing at pin 13 of IC U99, replace IC U36. If the pulse is missing at pin 12 of IC U99, check IC U99 by substitution.

SYSTEM BOARD LOGIC

PIN NO.	IC U1	PIN NO.	IC U2	PIN NO.	IC U2	PIN NO.	IC U3	PIN NO.	IC U3	PIN NO.	IC U5	IC U6	IC U7	IC U8	IC U9
1	P	1	P	15	P	1	L	21	L	1	H	L	P	P	P
2	L	2	P	16	P	2	P	22	P	2	H	P	P	P	P
3	L	3	H	17	P	3	P	23	H	3	H	P	P	P	P
4	P	4	P	18	P	4	P	24	P	4	P	P	P	P	P
5	P	5	P	19	L	5	P	25	P	5	P	P	P	P	P
6	P	6	P	20	H	6	P	26	P	6	P	P	P	P	P
7	H	7	P	21	H	7	P	27	P	7	L	P	P	P	P
8	*	8	P	22	H	8	P	28	P	8	P	P	P	P	P
		9	P	23	H	9	P	29	P	9	*	P	P	P	P
		10	P	24	L	10	P	30	H	10	*	L	L	L	L
		11	P	25	H	11	P	31	H	11	P	P	P	P	P
		12	L	26	P	12	P	32	P	12	P	P	P	P	P
		13	L	27	P	13	P	33	L	13	*	H	P	P	P
		14	L	28	H	14	P	34	H	14	H	P	P	P	P
						15	P	35	P	15		P	P	P	P
						16	P	36	P	16		P	P	P	P
						17	L	37	P	17		P	P	P	P
						18	L	38	P	18		P	P	P	P
						19	P	39	P	19		P	P	P	P
						20	L	40	H	20		H	H	H	H
PIN NO.	IC U10	IC U11	IC U12	IC U13	IC U14	IC U15	IC U16	IC U17	IC U18	IC U19	IC U23	IC U24	IC U26	IC U27	IC U29
1	P	L	H	P	P	L	P	P	P	P	H(1)	L(1)	H	P	P
2	P	P	P	P	H	P	P	P	P	P	L	H	H(1)	L	P
3	P	P	P	P	P	P	P	P	P	P	L(1)	H	L(1)	P	P
4	P	P	P	P	P	P	P	P	P	H	H	L(1)	H(1)	P	P
5	P	P	P	P	P	P	P	P	P	H	L(1)	L(1)	H(1)	P	P
6	H	L	P	P	H	P	P	P	P	P	L	L(1)	L(1)	P	P
7	*	H	P	P	H	P	P	P	P	P	L(1)	L(1)	H(1)	L	P
8	*	P	P	P	H	P	P	P	P	L	H	L(1)	L	L	P
9	H	L	P	P	H	P	P	P	P	P	L(1)	H(1)	P	P	P
10	L	L	L	L	L	L	L	L	L	P	L	L(1)	P	P	P
11	P	H	P	P	H	P	P	P	P	P	H	L(1)	P	P	L
12	H	P	P	P	H	P	P	P	P	H	L(1)	L(1)	P	H	L
13	*	L	P	P	H	P	P	P	P	P	H	L(1)	*	L	P
14	*	*	P	P	H	P	P	P	P	P	L(1)	L(1)	L	H	P
15	H	L	P	P	P	P	P	P	P	P	L	L(1)	L	P	P
16	P	P	P	P	H	P	P	P	P	H	L(1)	L(1)	H	P	P
17	P	P	P	P	P	P	P	P	P		H	L(1)		P	P
18	P	H	P	P	H	P	P	P	P		L(1)	H		P	P
19	P		P	P	L	L	P	P	P		H(1)	H		P	P
20	H		H	H	H	H	H	H	H		H	H		H	H
21															P
22															P
23															P
24															H

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No light On)
(1) Probe indicates P when a key is pressed.

KEYBOARD TYPE 2 LOGIC

PIN NO.	IC M1	PIN NO.	IC M1	PIN NO.	IC M2	IC M3	IC Z1
1	H(1)	21	P	1	*	*	H
2	P	22	P	2	*	*	P
3	P	23	P	3	L(1)	*	P
4	H	24	P	4	L(1)	*	L
5	H	25	H	5	L(1)	H	H
6	L(1)	26	H	6	L(1)	L	H
7	L	27	P	7	L	L	*(1)
8	H	28	P	8	H(1)	L	*
9	H	29	P	9	H(1)	H	*(1)
10	H	30	P	10	H(1)	H	*(1)
11	P	31	P	11	H(1)	P	*(1)
12	H	32	P	12	*	H	*(1)
13	H	33	P	13	*	H	*(1)
14	H	34	P	14	H	H	*
15	H	35	P	15			P
16	H	36	P	16			P
17	L(1)	37	P	17			P
18	H(1)	38	P	18			H
19	P	39	P	19			*(1)
20	L	40	H	20			*(1)

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
 Logic Probe Display
 L = Low P = Pulse
 H = High * = Open (No light On)
 (1) Probe Indicates P when a key is pressed.

PRINTER ADAPTER LOGIC

PIN NO.	IC U1	IC U2	IC U3	IC U4	IC U5	IC U6	IC U7	IC U8	IC U9	IC U10	IC U11
1	P	P	H	L	P	P	H	P	L	*	L
2	P	L	P	P	P	L	P	P	H	*	H
3	P	P	P	P	P	P	P	H	H	*	H
4	P	H	P	P	P	H	P	L	P	P	L
5	P	P	P	P	P	H	L	L	P	H	P
6	P	P	P	P	P	P	L	H	P	P	P
7	P	P	P	P	L	H	H	L	L	L	L
8	P	P	L	P	P	L	L	L	P	P	H
9	P	P	P	L	*	P	P	H	H	L	L
10	L	L	L	L	*	H	H	H	L	H	H
11	P	L	P	P	P	P	P	L	L	H	P
12	P	P	P	P	P	H	L	L	L	H	H
13	P	L	P	P	*	P	P	H	H	H	P
14	P	P	P	P	H	P	P	H	H	H	H
15	P	H	P	P		P	L				
16	P	P	P	P		H	H				
17	P	P	P	P							
18	P	P	P	P							
19	L	H	H	H							
20	H	H	H	H							

NOTE: Logic probe readings taken while running the following program.

10 PRINT "PERSONAL"
 20 GOTO 10

Logic Probe Display
 L = Low P = Pulse
 H = High * = Open (No light On)

TROUBLESHOOTING (Continued)

SYSTEM BOARD

SYSTEM BOARD DIP SWITCHES

There are two DIP Switches (SW1 and SW2, 8 switches each) located on the System Board that must be set according to the number of 5 1/4" Disk Drives, type of Monitor Adapter (Monochrome Monitor/Printer or Color Graphic Monitor) used and the amount of RAM memory available. Use the following charts to determine the proper switch settings.

SW1

Number of 5 1/4" Drives	SW1 ON	SW1 OFF
0	1,7,8	
1	7,8	1
2	8	1,7

Math Coprocessor Installed	2
Math Coprocessor Not Installed	2

RAM Memory Installed on System Board

64K - 256K System Board	3,4
16K - 64K System Board	
16K	3,4
32K	4
48K	3
64K	3,4

Monitor Adapter Installed	ON	OFF
None	5,6	
Monochrome Monitor/Printer Adapter		5,6
Color Graphics Monitor Adapter (40 x 25 Color)	6	5
Color Graphics Monitor Adapter (80 x 25 Color)	5	6

SW2

Note: Switches 6, 7 and 8 are always OFF.

16K - 64K System Board	SW2 ON	SW2 OFF
16K to 64K (on Main Board)	1,2,3,4,5	
96K	2,3,4,5	1
128K	1,3,4,5	2
160K	3,4,5	1,2
192K	1,2,4,5	3
224K	2,4,5	1,3
320K	1,2,3,5	4
352K	2,3,5	1,4
384K	1,3,5	2,4
416K	3,5	1,2,4
448K	1,2,5	3,4
480K	2,5	1,3,4
512K	1,5	2,3,4
544K	5	1,2,3,4
576K	1,2,3,4	5
608K	2,3,4	1,5
640K	1,3,4	2,5

64K - 256K System Board

	SW2 ON	SW2 OFF
64K	1,2,3,4,5	
128K	1,3,4,5	2
192K	1,2,4,5	3
256K	1,4,5	2,3
288K	4,5	1,2,3
320K	1,2,3,5	4
352K	2,3,5	1,4
384K	1,3,5	2,4
416K	3,5	1,2,4
448K	1,2,5	3,4
480K	2,5	1,3,4
512K	1,5	2,3,4
544K	5	1,2,3,4
576K	1,2,3,4	5
608K	2,3,4	1,5
640K	1,3,4	2,5

MICROPROCESSOR CHIP (CPU) OPERATION

Microprocessor IC (U3) does not appear to be functioning. Check for 5V at pin 40 of IC U3. If the 5V is missing, refer to the "Power Supply" section of this Troubleshooting guide. If the 5V source is normal, check the clock waveform at pin 9 of IC U99. If the waveform is missing, refer to the "Clock Generator" section of this Troubleshooting guide. If the waveform is good, turn off the computer and check pin 21 of IC U3 for a reset pulse of about .3 sec width when the computer is turned back on. If the reset pulse is missing, check the Clock Generator IC (U11) by substitution. If the reset pulse is good, check pin 18 of IC U3 for a low or pulse logic reading. If pin 18 stays high, check Interrupt Controller IC (U2) and IC U3 by substitution. If the reading on pin 18 is a low or pulse, check for a low reading on pin 17 of IC U3. If pin 17 reading is high, check the logic readings on pins 1 and 2 of IC U97. If the readings are good check IC U97 by substitution. Check for pulses on pins 2 thru 16 and 35 thru 39 of IC U3. If any of the pins are stuck in the high or low state, check IC U3 by substitution.

CLOCK GENERATOR

Check the frequency (14.31818MHz) at pin 12 of the Clock Generator IC (U11). If the frequency is off, adjust the Color Adjust Trimmer (T1) for the proper frequency. If the proper frequency cannot be obtained or the oscillator is not functioning, check for 5V at pin 18 of IC U11, Crystal (Y1), Trimmer (T1) and Resistors R13 and R14. Also, check IC U11 by substitution. Check for a high logic reading at pin 11 of IC U11. If the reading is low it will disable the clock signal at pin 5 of IC U11. If the reading is low, check the connection at pin 1 of Plug P1 and check Power-Good Driver Transistor (Q4) on the Power Supply Board. If the plug and transistor are good, the power supply may be in shutdown condition. Refer to the "Power Supply (Shutdown)" section of this Troubleshooting guide. Check the waveforms at pins 4, 5, 8 and 12 of IC U11. If any of the waveforms are missing, check IC U11 by substitution.

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IBM

SYSTEM BOARD (Continued)

ROM AND RAM

Except for the Basic Input Output System (BIOS) ROM IC (U33), the self-test (that is built into the computer) checks the RAM and ROMS automatically when the unit is turned On and momentarily displays an error code on the monitor screen if a defective IC is found.

When a RAM failure occurs, an alphanumeric code will be momentarily displayed at the top left corner of the monitor screen. This code will be four characters followed by 201. The number 201 indicates it is a memory failure. The first two characters indicate which bank has the bad IC. The third and fourth characters indicate which row in that bank is defective. The RAM bank that is soldered in is Bank 0. Use the following charts to find the defective IC.

		First Two Characters	
		16K/64K System Board	64K/256K System Board
Bank 0		00	00
Bank 1		04	10
Bank 2		08	20
Bank 3		0C	30

		Third and Fourth Characters							
Row	Parity	0	1	2	3	4	5	6	7
Characters	00	01	02	04	08	10	20	40	80

Example: 1020 201 would be bank 1 row 5, IC (U59) on the 64K/256K system board.

If the third and fourth characters do not match those given in the chart, substitute the entire nine ICs of that bank and recheck the memory. If an error code still appears, troubleshoot the RAM address decode and chip select circuits.

When a ROM failure occurs on the 64K/256K System Board a four character alphanumeric code will appear on the monitor screen. Use the following chart to determine which IC is indicated and check the IC by substitution.

ROM CODE CHART	
CODE	DEVICE
F600	U29
F800	U30
FA00	U31
FC00	U32

ROM IC U33 is not checked since it contains the test program. If IC U33 does not appear to be functioning, check it by substitution. If IC U33 still does not function, check for pulses at pin 20 of IC U33. If the pulses are missing, check the logic probe readings on pins 1 thru 6 of Decoder IC (U46). If the readings are normal, check IC U46 by substitution.

CASSETTE OPERATION

The computer is not saving data to a cassette recorder or turning the cassette motor On and Off. Put the computer in Cassette (ROM) Basic mode, see the "Basic" section of the General Operating instructions. Type in and run the following Basic program:

10 SAVE "TEST": GOTO 10

This program will turn the cassette motor On, save itself on tape and repeat the procedure continuously.

If the data is not being saved on tape, check for pulses at pin 3 of IC U63. If the pulses are present, check the Relay K1, the connection at pin 5 of the Cassette Connector (J6), Capacitor C5 and Resistors R6 thru R9. If pulses are missing at pin 3 of IC U63, check for pulses at pin 1 of IC U63. If these pulses are missing, check IC U63 by substitution. If the pulses are missing at pin 1 of IC U63, check Timer IC (U34) by substitution.

If the computer will not read data from the cassette, connect a cassette recorder to the computer and make the following checks while loading a program from tape, see "Cassette Operation" section of the General Operating Instructions. Check for pulses at the cathode of Diode D1. If the pulses are present, check Peripheral Interface IC (U36) by substitution. If the pulses are missing, check the connection at pin 4 of the Cassette Connector (J6), Relay K1 and the voltages and components associated with IC U1 and check Diode D1.

If the cassette motor is not starting, check for a high logic reading at pin 2 of Peripheral Driver IC (U95). If the reading is high, check for a low logic reading at pin 3 of IC U95. If the reading is not low, check IC U95 by substitution. If the reading is low, check the Relay K1 and the connections at pins 1 and 2 of the Connector J6. If the reading at pin 2 of IC U95 does not read high, check for a low logic reading at pin 4 of IC U63. If the reading is low, check Resistor Network RN3 and check IC U63 by substitution. If the reading at pin 4 of U63 is not low, check IC U36 by substitution.

LINE DEFINITIONS

A0 Thru A19	Address Lines
ACK	Acknowledge
AD0 Thru AD7	
ADSTB	
ADDR SEL	Address Select
AEN	Address Enable
AEN BRD	
ALE	Address Latch Enable
AUTO FD XT	Auto Feed External Lines
BA8 Thru BA19	Buffer Address Lines
BD0 Thru BD7	Buffer Data
BUSY	Busy
CAS	Column Address Strobe
CAS0 Thru CAS3	Column Address Strobe Lines
CASS DATA IN	Cassette Data In
CLK	Clock
CLK88	
CS2 Thru CS7	Chip Select Lines
D0 Thru D7	Data Lines
DACK0 Thru DACK3	Direct Memory Access Acknowledge Lines
DACK0 BRD	
DATA IN	Data In
DATA OUT	Data Out
DCLK	Data Clock
DIR	Direction
DMA AEN	Direct Memory Access Address Enable
DMA CS	Direct Memory Access Chip Select
DMA WAIT	Direct Memory Access Wait
DRQ0 Thru DRQ3	
DT/R	Data Transmit Receiver
ERROR	Error
EN I/O CK	
EN I/O CLK	Enable I/O Clock
ENB RAM PCK	
G	Enable
HOLDA	Hold Access
I/O CH CK	I/O Channel Check
I/O CH CLK	I/O Channel Check
I/O CH RDY	I/O Channel Ready
INIT	Initialize
INT	Interrupt
INTA	Initialize Address
INTR CS	Internal Chip Select
IOR	I/O Read
IOW	I/O Write
IRQ0 Thru IRQ7	Interrupt Request Lines
IRQ EN	Interrupt Enable
LOCK	Lock
MA0 Thru MA7	Memory Address Lines
MD0 Thru MD7	Memory Data Lines
MD00 Thru MD11	Matrix Data Lines
MDP	
ME	Memory Enable
MEMR	Memory Read
MEMW	Memory Write
MOTOR CNTRL	Motor Control

MOTOR OFF	Motor Off
MRQ DMA	Memory Request Direct Memory Access
NMI	Non-Maskable Interrupt
NP INSTL SW	
NPNPI	
OSC	Oscillator
PB6, PB7	
PCK	
PCLK	Peripheral Clock
PE	Paper End
PPICS	
PWR GOOD	Power Good
QS0, QS1	
RAM ADDR SEL	RAM Address Select
RAS	Row Address Strobe
RAS0 Thru RAS3	Row Address Strobe
RDY/WAIT	Ready/Wait
RDY TO DMA	Ready to Direct Memory Access
READY	Ready
REFRESH GATE	Refresh Gate
REQIN	Request In
REQOUT	Request Out
REQUEST/CLOCK	Request Clock
RESET	Reset
RESET DRV	Reset Drive
ROM ADDR SEL	ROM Address Select
RQ/GT	
RPA	Read Printer Data
RPB	Read Printer Control
RPC	Read Printer Status
S0 Thru S2	Status
SA CLOSED	
SELECT 0 Thru SELECT 2	Select Lines
SENSE A Thru SENSE H	Sense Lines
SERIAL DATA	Serial Data
SLCT	Select
SLCT IN	Select Input
SP/EN	Slave Program/Enable Buffer
SPKR DATA	Speaker Data
STROBE	Strobe
T/C	Terminal count
TC	
TC CS	
T/M 2 GATE SPK	
TIMER/CNTR 2	Timer Control 2
WE	Writer Enable
WPA	Write Printer Data
WPC	Write Printer Control
WRT DMA PG REG	Write Direct Memory Access Page Register
WRT NMI REG	Write Non-Maskable Interrupt Register
XA0 Thru XA12	Buffered Address Lines
XD0 Thru XD7	Buffered Data Lines
XIOR	Buffered I/O Read
XIOW	Buffered I/O Write
XMEMR	Buffered Memory Read
XMEMW	Buffered Memory Write

Any Bar above any alphabetical or numerical combination indicates line active in a low (0) state.

SCHEMATIC NOTES (Continued)

PRINTER ADAPTER

NOTE: Voltages, waveforms and logic probe readings taken while running the following program.

10 PRINT "PERSONAL"
20 GOTO 10

SAFETY PRECAUTIONS

- 1. Use an isolation transformer for servicing.
- 2. Maintain AC line voltage at rated input.
- 3. Remove AC power from the computer system before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.
- 4. Use extreme caution when handling the printed circuit boards. Some semiconductor devices can be damaged easily by static electricity. Drain off any electrostatic charge on your body by touching a known earth ground. Wear a commercially available discharging wrist strap device. This should be removed prior to applying power to the unit under test.
- 5. Use a grounded-tip, low voltage soldering iron.
- 6. Use an isolation (times 10) probe on scope.
- 7. Do not remove or install boards, floppy disk drives, printers, or other peripherals with computer system AC power On.
- 8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.
- 9. This computer system is equipped with a grounded three-pronged AC plug. This plug must fit into a grounded AC power outlet. Do not defeat the AC plug safety feature.
- 10. Periodically examine the AC power cord for damaged or cracked insulation.
- 11. The computer system cabinet is equipped with vents to prevent heat build-up. Never block, cover, or obstruct these vents.
- 12. Instructions should be given, especially to children, that objects should not be dropped or pushed into the vents of the cabinet. This could cause shock or equipment damage.
- 13. Never expose the computer system to water. If exposed to water turn the unit off. Do not place the computer system near possible water sources.
- 14. Never leave the computer system unattended or plugged into the AC outlet for long periods of time. Remove AC plug from AC outlet during lightning storms.
- 15. Do not allow anything to rest on AC power cord.
- 16. Unplug AC power cord form outlet before cleaning computer system.
- 17. Never use liquids or aerosols directly on the computer system. Spray on cloth and then apply to the computer system cabinet. Make sure the computer system is disconnected from the AC power line.

SCHEMATIC NOTES

- Circuitry not used in some versions
- Circuitry used in some versions
 - See parts list
 - ⊥ Ground
 - Chassis
 - Common tie point
- Waveforms and voltages taken from ground, unless noted otherwise.
- Voltages, Waveforms and Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
- Waveforms taken with triggered scope and Sweep/Time switch in Calibrate position, scope input set for DC coupling on 0 reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 7 cm. width with DC reference voltage given at the bottom line of each waveform.
- Time in μsec. per cm, given with p-p reading at the end of each waveform.
- Item numbers in rectangles appear in the alignment/adjustment instructions.

Supply voltages maintained as shown at input.
Voltages measured with digital meter, no signal.
Controls adjusted for normal operation.
Terminal identification may not be found on unit.
Capacitors are 50 volts or less, 5% unless noted.
Electrolytic capacitors are 50 volts or less, 20% unless noted.
Resistors are ½W or less, 5% unless noted.
Value in () used in some versions.
Measurements with switching as shown, unless noted.

Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No light On)

(1) Probe indicates P when a key is pressed.
(2) Probe indicates H when speakers sounds.
(3) Probe indicates P while beeping speaker.
(4) Probe indicates L when cassette motor turns On.
(5) Probe indicates H when cassette motor turns Off.

TROUBLESHOOTING (Continued)

SYSTEM BOARD (Continued)

INTERNAL SPEAKER

No sound from the speaker. Check the Speaker (SP1) and the Speaker Plug (P3) for a good connection. If the speaker and plug check normal, put the computer in Basic mode, see the "Basic" section of the General Operating Instructions. Type in and run the following Basic program to produce a continous sound signal to the speaker.

10 SOUND 200, 200: GOTO 10

Check for pulses at pin 11 of IC U63. If the pulses are present, check Capacitor C9, Resistor R10 and check IC U95 by substitution. If the pulses are missing at pin 11 of IC U63, check for pulses at pin 13 of IC U63. If pulses are missing, check for a high logic reading at pin 16 of Timer IC (U34). If the reading is not high, replace Peripheral Interface IC (U36). If the reading is high, replace IC U34. If pulses are present at pin 13 of IC U63, check for a high logic reading at pin 12 of IC U63. IF the reading is not high, check IC U36 by substitution. If the reading is high, check Resistor Network RN3 and check IC U63 by substitution.

PRINTER ADAPTER

PRINTER ADAPTER

Printer adapter is not functioning. Check the edge connector and the Printer Connector (P1) for good connections. Clean the contacts if they appear dirty. If the printer is still not functioning, type in and run the Basic program used to take the measurements on the Printer Adapter, see the Printer Adapter Schematic Notes. Check the waveform at pin 1 of Line Drivers IC (U2). If the waveform is missing or incorrect, check the waveforms at pins 1 and 15 of Decoder IC (U6). If the waveforms are normal, check IC U6 by substitution. If the waveforms are not correct, check IC U9, IC U5 and IC U11 by substitution. If the waveform at pin 1 of IC U2 is good, check for a high logic reading at pin 19 of IC U2. If the reading is not high check IC U6 by substitution. If the reading is high, check the logic probe readings on pins

12 and 13 of IC U8, pins 1 and 2 of IC U9, pins 1, 2, 3, 11 and 13 of IC U11 and pin 8 of IC U2. If any reading is incorrect, check the IC connected to that point by substitution. If the readings are normal, check for a high logic reading at pin 10 of IC U8. If the reading is not high, check for a high logic reading at pin 3 of IC U8. If the reading is high, check Capacitor C21 and check IC U8 by substitution. If the reading is not high, check Flip/Flop IC (U7) by substitution. Check for pulses at pins 1 and 2 of IC U8. If the pulses are present at pin 1 but missing at pin 2, check Resistor Network (RP1) and check IC U8 by substitution. If the pulses are missing at pin 1, check IC U7 by substitution.

Printer is functioning but not printing the correct characters. Check the Latch IC (U4) by substitution.

MONOCHROME MONITOR/PRINTER ADAPTER

PRINTER SECTION

Printer section of the Monochrome Monitor/Printer Adapter is not functioning. Check the edge connector and the Printer Connector (J4) for good connection and clean the contacts if they appear dirty. If the printer is still not functioning, type in and run the Basic program used to take measurements on the printer section of the adapter, see Monochrome Monitor/Printer Adapter Schematic Notes. Check the waveform at pin 1 of Bus Buffer IC (U37). If the waveform is missing or incorrect, check the waveforms at pins 1 and 15 of Decoder IC (U61). If the waveforms are normal, check IC U61 by substitution. If the waveforms are not correct check IC U57 and IC U62 by substitution. If the waveform at pin 1 of IC U37 is good, check for a high logic reading at pin 19 of IC U37. If the reading is not high check IC U61 by substitution. If the reading is high, check the logic probe readings on pins 5 and 6 of IC U38, pins 8 and 9 of IC U56, pins 10 and 11 of IC U44, pins 9 and 10 of IC U57 and pin 8 of IC U37. If any reading is incorrect, check the IC connected to that point by substitution. If the readings are normal, check for a high logic reading at pin 8 of IC U38. If the reading is not high, check for a high logic reading at pin

11 of IC U38. If the reading is high, check IC U38 by substitution. If the reading is not high, check Control Latch IC (U39) by substitution. Check for pulses at pins 1 and 2 of IC U38. If the pulses are present at pin 1 but missing at pin 2, check Resistor Network (RP1) and check IC U38 by substitution. If the pulses are missing at pin 1, check IC U39 by substitution.

If the printer is functioning but not printing the correct characters, check the Bus Buffer IC (U41) by substitution.

VIDEO RAM

The character codes for the characters which appear on the monitor screen are stored in RAM ICs (U12) thru (U14). The top half of the screen uses ICs U13 and U14 for storage while ICs U12 and U14 are used for the bottom half. If one or more locations in the top half of the screen always stays the same, check ICs U13 and U14 by substitution. If one or more locations in the bottom half of the screen always stays the same, check ICs U12 and U14 by substitution.

CS CS2
IBM
MODEL 5150

MONOCHROME MONITOR/PRINTER ADAPTER (Continued)

VERTICAL SYNC

No vertical sync. Check the waveform at pin 9 of Output Buffer IC (U64). If the waveform is present, check pin 9 of Connector J3 for a good connection and also check the monitor cable for possible open circuits. If the waveform is missing, check the waveform at pin 11 of IC U64. If the waveform is normal, check IC U64 by substitution. If the waveform is missing, check the waveform at pin 1 of IC U54. If the waveform is normal, check IC U54 by substitution. If the waveform is missing, check the waveforms at pins 9 and 14 of Flip/Flop IC (U55). If the waveforms are normal, check IC U55 by substitution. If the waveform at pin 9 of IC U55 is missing, check IC U2 by substitution. If the waveform at pin 14 of IC U55 is missing, check CRT Controller IC (U35) by substitution.

Vertical sync is off frequency. Check pin 6 of Flip/Flop IC (U24) for proper frequency from the 16.257MHz Oscillator (OSC 1). If the oscillator is off frequency, check OSC 1 by substitution. If the OSC 1 is working properly, check the waveform at pin 21 of IC U35. If the waveform is normal, check IC U35 by substitution.

HORIZONTAL SYNC

No horizontal sync. Check the waveform at pin 5 of Output Buffer IC (U64). If the waveform is present, check pin 8 of Connector J3 for good connection and check the Monitor cable for a possible open circuit. If the waveform is missing, check the waveform at pin 13 of IC U64. If the waveform is normal, check IC U64 by substitution. If the waveform is bad, check the waveform at pin 5 of IC U3 and check for a high logic reading at pin 4 of IC U3. If the waveform is good and the logic reading is high, check IC U3 by substitution. If pin 4 of IC U3 logic reading is low, check Flip/Flop IC (U45) by substitution. If the waveform is missing at pin 5 of IC U3, check the waveform at pin 12 of Flip/Flop IC (U55). If the waveform is normal, check ICs U100 and U101 by substitution. If the waveform is missing, check the waveform at pin 13 of IC U55. If the waveform is good, check IC U55 by substitution. If the waveform is missing, check CRT Controller IC (U35) by substitution.

Horizontal sync is off frequency. Check the frequency of the 16.257MHz Oscillator (OSC 1) at pin 6 of Flip/Flop IC (U24). If OSC1 is off frequency, check OSC 1 by substitution. If OSC1 is working properly, check the waveform at pin 21 of IC U35. If the waveform is good, check IC U35 by substitution.

VIDEO

No video on the Monitor screen, check the waveforms at pins 5, 7 and 9 of Output Buffer IC (U64). If the waveforms are present, check pins 7, 8 and 9 of Connector J3 for good connection and check Resistor R1 and Capacitor C3. If the waveform is normal at pin 5 and missing at pin 7 (Horizontal Sync) or pin 9 (Vertical Sync) of IC U64, refer to the "Horizontal or Vertical Sync" section of this Troubleshooting guide. If the sync waveforms are normal and the waveform at pin 5 of IC U64 is missing, check the waveform at pin 13 of the Shift Register IC (U32). If the waveform is missing and the logic probe readings are normal for the rest of the pins of IC U32, check IC U32 by substitution. If the waveform is normal, check the waveform at pin 11 of IC U43. If the waveform is missing, check IC U43 by substitution. If the waveform is normal, check waveform at pin 8 of IC U26. If the waveform is missing and the logic readings on pins 9 and 11 of IC U26 are high, check IC U26 by substitution. If the waveform is normal, check the waveform at pin 8 of IC U43. If the waveform is missing, check IC U43 by substitution. If the waveform is normal, check the waveform at pin 6 of IC U54. If the waveform is missing, check IC U54 by substitution. If the waveform is normal, check the waveform at pin 5 of Flip/Flop IC (U101). If the waveform is missing and the waveforms at pins 1 and 3 of IC U101 are normal, check IC U101 by substitution. If the waveform at pin 5 of IC U101 is normal, check IC U64 by substitution.

If the waveforms at pins 5, 7 and 9 of IC U64 are missing, check the waveforms at pins 5, 11, 13 and 15 of IC U64. If the waveforms are normal, check IC U64, by substitution. If the waveforms are missing, check the waveform pin 6 of Flip/Flop IC (U24). If the waveform is missing, check the 16.257MHz Oscillator IC (OSC 1) by substitution. If the waveform is good, check the waveforms on pins 7 and 9 of IC U24. If either waveform is missing, while pin 2 of IC 24 has a low logic reading and the waveform on pin 10 of IC U24 is normal, check IC U24 by substitution. If all the waveforms are good on IC U24, check for pulses on pin 5 of Flip/Flop IC (U5). If the pulses are missing and the logic readings are good on pins 2, 3 and 15 of IC U5, check IC U5 by substitution. If the pulses are present, check for pulses at pin 13 of IC U57. If the pulses are missing, check IC U57 by substitution. If pulses are present, check for pulses at pin 8 of IC U2. If the pulses are missing, check IC U2 by substitution. If pulses are present, check the waveform at pin 18 of CRT Controller IC (U35). If the waveform is missing and the logic probe readings are normal at pins 2 and 22 thru 25 of IC U35, check IC U35 by substitution.

One or more characters do not come up properly on the Monitor screen and the character always look the same regardless of its location on the screen. Check the Character Generator IC (U33) by substitution.

If the characters are wrong only in one location on the Monitor screen, refer to the "Video RAM" section of this Troubleshooting Guide.

ALIGNMENT

DISK DRIVES (A & B) TYPE 1

EQUIPMENT REQUIRED

A test program or a Disk Drive Tester is required which will turn On the Disk Drive and step the head to the track specified in the alignment procedures. Use a Dysan Analog Alignment Diskette 224/2A when an Alignment Diskette is specified in the alignment procedures. NOTE: This alignment diskette has only alignment patterns on it and does not contain any alignment programs.

SPINDLE SPEED ADJUSTMENT

Insert a blank diskette into the Disk Drive and close the door. Turn the Disk Drive on its side so the pattern wheel on the fly wheel is visible. Adjust the Speed Control (R4) until the 60Hz pattern appears to stand still under a 60Hz fluorescent light. If 50Hz fluorescent lighting is used, use the 50Hz pattern on the pattern wheel.

If a Disk Drive Tester is being used, which provides a readout of the speed in rpm, adjust R4 for a speed of 300rpm \pm 1.5%.

TRACK 00 SWITCH ADJUSTMENT AND STOP ADJUSTMENT

Insert the Alignment Diskette into the Disk Drive and close the door. Turn On the Disk Drive and set the head to track 16. Confirm that the head is on track 16 by observing the cats-eye pattern, see the "Radial Head Alignment" in this Alignment guide. If the cats-eye pattern is not correct, perform the Radial Head Alignment.

To adjust the Track 00 Switch (SW2), set the head to track 01. Loosen the retaining screw at the base of the Track 00 switch bracket and turn the Track 00 Switch Adjustment Screw Maximum counter-clockwise, see Disk Drive Mechanical Photo, Top View. Turn the screw clockwise until a "click" is heard and then turn the screw clockwise one half turn more. Retighten the Track 00 switch bracket retaining screw.

To adjust the Track 00 Stop Adjustment Screw, connect the input of a scope to TP1 and set the sweep time to 10 μ s and the voltage range to .5V. Insert the Alignment Diskette and close the door. Turn On the drive and set the head to track 00. A 125kHz sine wave of about .6V peak to peak should appear on the scope. Turn the Track 00 Stop Adjustment Screw clockwise until the amplitude of the 125kHz signal just starts to decrease then turn the screw counterclockwise 1/2 turn, see Disk Drive Mechanical - Top View Photo. Apply a small amount of cement to the screw to keep it in place.

RADIAL HEAD ALIGNMENT

Connect the channel A input of a dual trace scope to TP1, channel B input to TP2, the external trigger input to TP7 and connect the scope ground to TP6. Set the scope to add mode with channel B inverted, sweep time to 20ms, AC input, trigger to positive slope and voltage to .2V range. Insert the Alignment Diskette, turn On the Disk Drive and set the head to track 16. Observe the cats-eye pattern, see Figure 1. The lobes should be within 80% of each other. If the lobes are out of tolerance, loosen the two head module retaining screws on the bottom of the Disk Drive and the

one screw on the top next to the Radial Head Alignment screw, see Disk Drive Mechanical - Top View Photo. Turn the Radial Head Alignment Screw until the lobes are within 80% of each other and retighten the three retaining screws.

Move the head to track 40 and back to track 16, then to track 00 and back to track 16, verifying that the lobes are within tolerance when the head is on track 16.

EQUAL AMPLITUDE

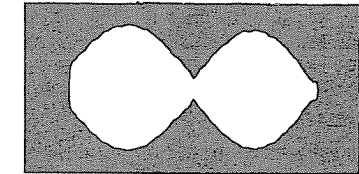


Figure 1

INDEX SENSOR ADJUSTMENT

Connect the channel A input of a dual trace scope to TP3, channel B input to TP7 (index pulse) and the scope ground to TP6. Set the scope display to channel A with the voltage range set to 20mV and the sweep time set to 50 μ s. Set the channel B input to noninverting mode and trigger the scope on channel B with the trigger set to positive slope.

Insert the Alignment Diskette in the Disk Drive and close the door. Turn On the Disk Drive and set the head to track 01. Confirm that the leading edge of the burst occurs 200 μ s \pm 50 μ s after the leading edge of the index pulse, see Figure 2. If the index sensor is out of adjustment, loosen the index sensor retaining screw on the bottom of the Disk Drive and use a flat blade screwdriver placed in the slots on the chassis and index sensor to adjust for 200 μ s \pm 50 μ s, see Disk Drive Mechanical, Bottom View Photo.

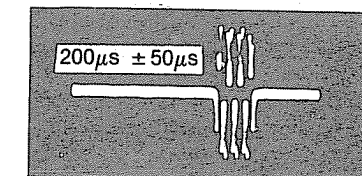


Figure 2

AZIMUTH CHECK

Connect the channel A input of a dual trace scope to TP1, channel B input to TP2, external trigger input to TP7 and connect the scope ground to TP6. Set the scope to add mode with channel B inverted, sweep time to .5ms, AC input, trigger to positive slope and voltage to .1V range.

Insert the Alignment Diskette, turn On the Disk Drive and set the head to track 34. Confirm that the pattern appears as shown in Figure 3. The amplitude of bursts 1 and 4 must be equal to or less than the amplitudes of bursts 2 and 3.

No adjustment is provided for the head azimuth. If the azimuth is out of tolerance, the head may need replacement.

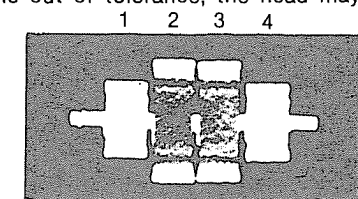
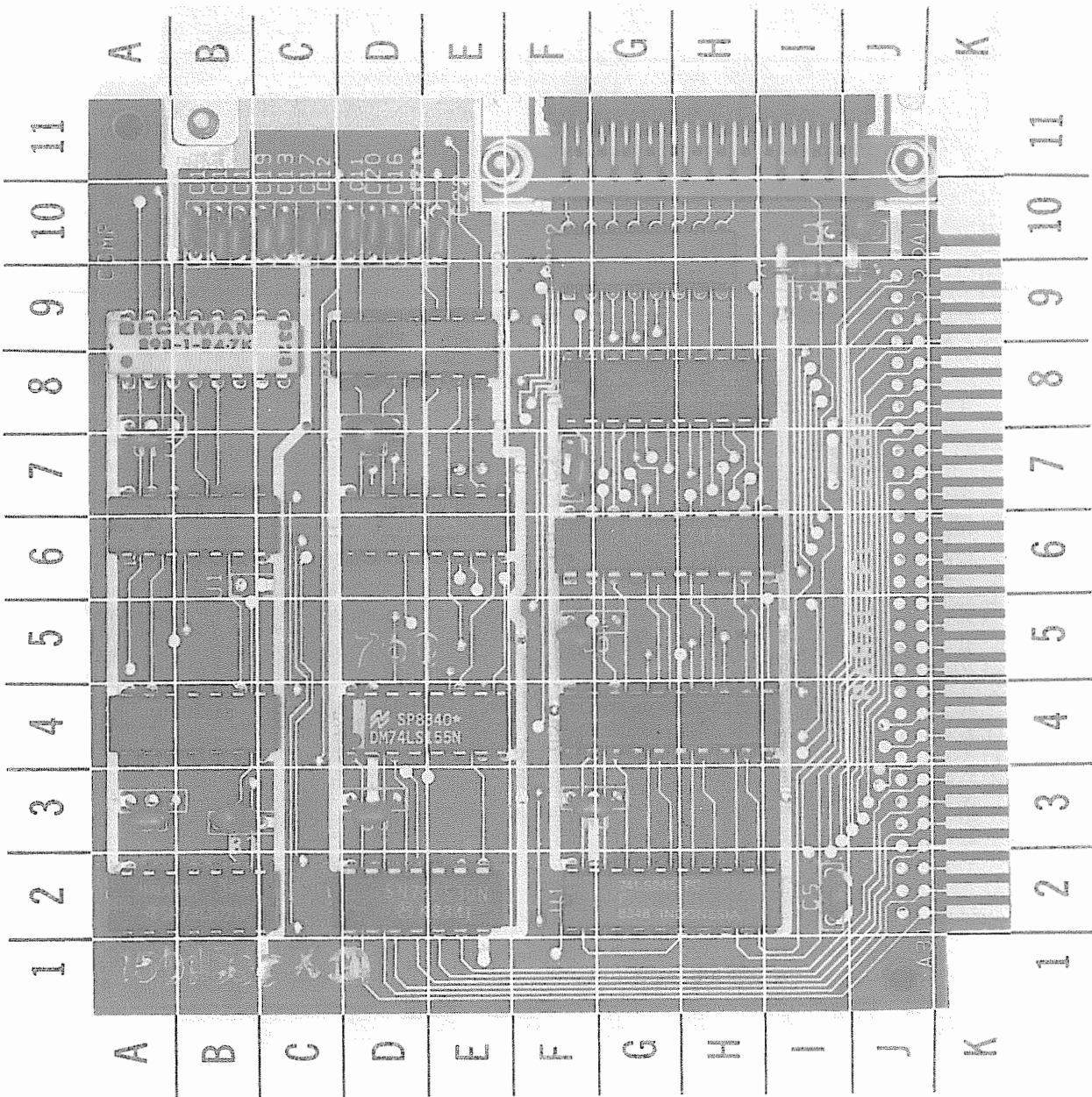


Figure 3

C1	J-10
C2	F-7
C3	F-5
C4	F-2
C5	I-2
C6	D-3
C7	D-8
C8	B-3
C9	A-3
C10	A-7
C11	D-10
C12	C-10
C13	C-10
C14	B-10
C15	B-10
C16	D-10
C17	C-10
C18	B-10
C19	C-10
C20	D-10
C21	D-10
C22	E-10
P1A	F-11
R1	I-9
RP1	A-8
RP2	A-8
U1	G-9
U2	G-2
U3	G-4
U4	G-6
U5	G-8
U6	D-2
U7	D-4
U8	D-8
U9	A-2
U10	A-4
U11	A-6



MONOCHROME MONITOR/PRINTER ADAPTER (Continued)

CURSOR

Monitor screen comes up normally but the cursor is missing. Check for pulses at pin 19 of CRT Controller IC (U35). If the pulses are missing, check IC U35 by substitution. If pulses are present, check for pulses at pin 10 of Flip/Flop IC (U55). If the pulses are missing, check IC U55 by substitution. If pulses are present, check for pulses at pin 8 of IC U44. If the pulses are missing, check IC U44 by substitution. If pulses are present, check for pulses at pin 8 of IC U3. If pulses are missing, check the waveform at pin 9 of IC U3. If the waveform is missing, check Counter IC (U28) by substitution. If the waveform is normal, check IC U3 by substitution. If pulses are present at pin 8 of IC U3, check IC U43 by substitution.

Cursor is present but it is not blinking. Check the waveform at pin 13 of IC U28. If the waveform is missing, check IC U28 by substitution.

BLINK, HIGHLIGHT, UNDERLINE AND REVERSE VIDEO

The blink, highlight, underline and reverse video features for each character location on the Monitor screen are controlled by the information put into RAM ICs U8 thru U10. The blink feature for the top half (first 1024 characters) of the screen is controlled by IC U9 and the bottom half (last 976 characters) by IC U8. The highlight and underline features for the top half of the screen are controlled by IC U11 and the bottom half by IC U10. The reverse video feature for the top half of the screen is controlled by ICs U9 and U11 and the bottom half by ICs U8 and U10.

To check the blink, highlight and underline features, put the unit into Basic mode, see the "Basic" section of the General Operating Instructions. Type in and run the following Basic program. This program will fill the screen with underlined, highlighted characters which are blinking.

```
1 DEF SEG = &HB000
2 FOR X = 0 TO 4000 STEP 2
3 POKE X, 42: POKE X + 1, 137
4 NEXT X
5 GOTO 5
```

If one or more characters in the top half of the screen are not blinking, check IC U9 by substitution. If a character in the bottom half of the screen is not blinking, check IC U8 by substitution. If one more more characters in the top half of the screen are not highlighted or underlined, check IC U11 by substitution. If a character in the bottom half of the screen is not highlighted or underlined, check IC U10 by substitution.

If the blink feature is not operating and the cursor is not blinking, check the waveform at pin 13 of IC U28. If the waveform is missing, check Counter IC (U28) by substitution.

If the blink feature is not operating but the cursor is blinking, check for pulses at pin 11 of IC U8. If the pulses are missing, check ICs U8 and U9 by substitution. If pulses are present, check for pulses at pin 19 of Flip/Flop IC (U31). If the pulses are not present, check IC U31 by substitution. If the pulses are present, check for pulses at pin 18 of Flip/Flop IC (U30). If pulses are missing, check IC U30 by substitution. If pulses are present, check for a high logic reading at pin 4 of IC U62. If the reading is not high, check Flip/Flop IC (U58) by substitution. If the reading is high, check for pulses at pin 11 of IC U28. If pulses are missing, check IC U28 by substitution. If pulses are present, check IC U62 by substitution.

If the highlight feature is not operating, check for pulses at pin 11 of IC U10. If the pulses are missing, check ICs U10 and U11 by substitution. If the pulses are present, check for pulses at pin 9 of IC U31. If the pulses are missing, check IC U31 by substitution. If pulses are present, check for pulses at pin 9 of IC U30. If the pulses are missing, check IC U30 by substitution. If pulses are present, check for pulses at pin 12 of Multiplexer IC (U63). If the pulses are missing, check IC U63 by substitution. If pulses are present, check for pulses at pin 12 of Output Buffer IC (U64). If the pulses are missing, check IC U64 by substitution. If pulses are present, check Resistor R2 and check for a good connection at pin 6 of Connector J3.

If the underline feature is not operating, check for pulses at pin 14 of IC U10. If the pulses are missing, check ICs U10 and U11 by substitution. If pulses are present, check for pulses at pin 2 of IC U31. If the pulses are missing, check IC U31 by substitution. If pulses are present, check for pulses at pin 14 of Multiplexer IC (U49). If the pulses are missing, check IC U49 by substitution. If pulses are present, check for pulses at pin 11 of Multiplexer IC (U47). If the pulses are missing, check IC U47 by substitution. If pulses are present, check for pulses at pin 12 of IC U44. If the pulses are missing, check IC U44 by substitution. If pulses are present, check for pulses at pin 10 of Flip/Flop IC (U29). If the pulses are missing, check IC U29 by substitution. If pulses are present, check IC U43 by substitution.

To check the reverse video feature, change number 137 in line 3 of the Basic program to 112 and run the program. The Monitor screen will fill up with characters in reverse video. If one or more characters in the top half of the screen are not in reverse video, check ICs U9 and U11 by substitution. If one or more characters in the bottom half of the screen are not in reverse video, check ICs U8 and U10 by substitution. If the reverse video is not operating, check for pulses at pin 15 of IC U49. If the pulses are missing, check IC U49 by substitution. If pulses are present, check for pulses at pin 7 of Multiplexer IC (U48). If the pulses are missing, check IC U48 by substitution. If pulses are present, check for pulses at pin 13 of IC U27. If the pulses are missing, check IC U27 by substitution. If pulses are present, check for pulses at pin 7 of IC U29. If the pulses are missing, check IC U29 by substitution. If pulses are present, check IC U54 by substitution.

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TROUBLESHOOTING (Continued)

COLOR GRAPHIC MONITOR ADAPTER

VIDEO RAM

RAM ICs (U50 thru U57) are used to store the information which appears on the Monitor screen. If one or more locations on the Monitor screen always stays the same, put the computer in Basic mode, see the "Basic" section of the General Operating Instructions. Type in and run the following program.

```
10 DEF SEG = &HB800
20 SCREEN 2
30 FOR X = 0 TO 16191
40 FOR Y = 1 TO 8
50 READ Z:POKE X,Z
60 IF PEEK(X) AND Z THEN 80
70 GOTO 150
80 POKE X,0
90 IF PEEK (X) AND Z THEN 150
100 NEXT Y
110 RESTORE
120 NEXT X
130 DATA 1,2,4,8,16,32,64,128
140 PRINT "MEMORY CHECKS GOOD":END
150 PRINT"IC U";58-Y;" MAY BE BAD"
160 GOTO 100
```

This program will detect any memory location which is stuck low (0V) or high (5V). If a bad memory location is found, the program will print the number of any possibly defective ICs on the Monitor screen and then continue with the test, which will take about 38 minutes to complete. If a printer is connected to the Computer, replace the word PRINT in line 150 with the word LPRINT to get a printout of any defective ICs.

VERTICAL SYNC

Vertical sync problems are observed on the Monitor connected to the RGB Video Jack (J2), while a Monitor connected to the composite Video Output Jack (J1(A)) functions properly. Check the waveform at pin 9 of Jack J2. If the waveform is normal, check the connection at pin 8 of J2. If the waveform is missing, check Capacitor C25 and check IC U67 by substitution.

No vertical sync at either Jack J2 or Jack J1(A). Check for pulses at pins 9 and 10 of IC U41. If pulses are present, check IC U41 by substitution. If the pulses are missing, check the waveform at pin 1 of Flip/Flop IC (U63). If the waveform is normal, check IC U63 by substitution. If the waveform is missing, check the waveform at pin 11 of Flip/Flop IC (U21). If the waveform is present, check IC U21 by substitution. If the waveform is missing, check CRT Control by substitution.

Vertical sync is good at Jack J2, but there is no vertical or horizontal sync at Jack J1(A). Check the waveform at pin 2 of Status Register IC (U24). If the waveform is normal, check Resistor R5 and check IC U24 by substitution. If the waveform is missing, check for pulses at pin 13 of IC U20. If pulses are normal, check IC U20 by substitution. If the pulses are missing, check IC U42 by substitution.

HORIZONTAL SYNC

Horizontal sync problems are observed on a monitor connected to the RGB Video Jack (J2) while a Monitor connected to the composite Video Output Jack (J1(A)) is normal. Check the waveform at pin 8 of Jack J2. If the waveform is normal, check the connection at pin 8 of Jack J2. If the waveform is missing, check Capacitor C24 and also check IC U67 by substitution.

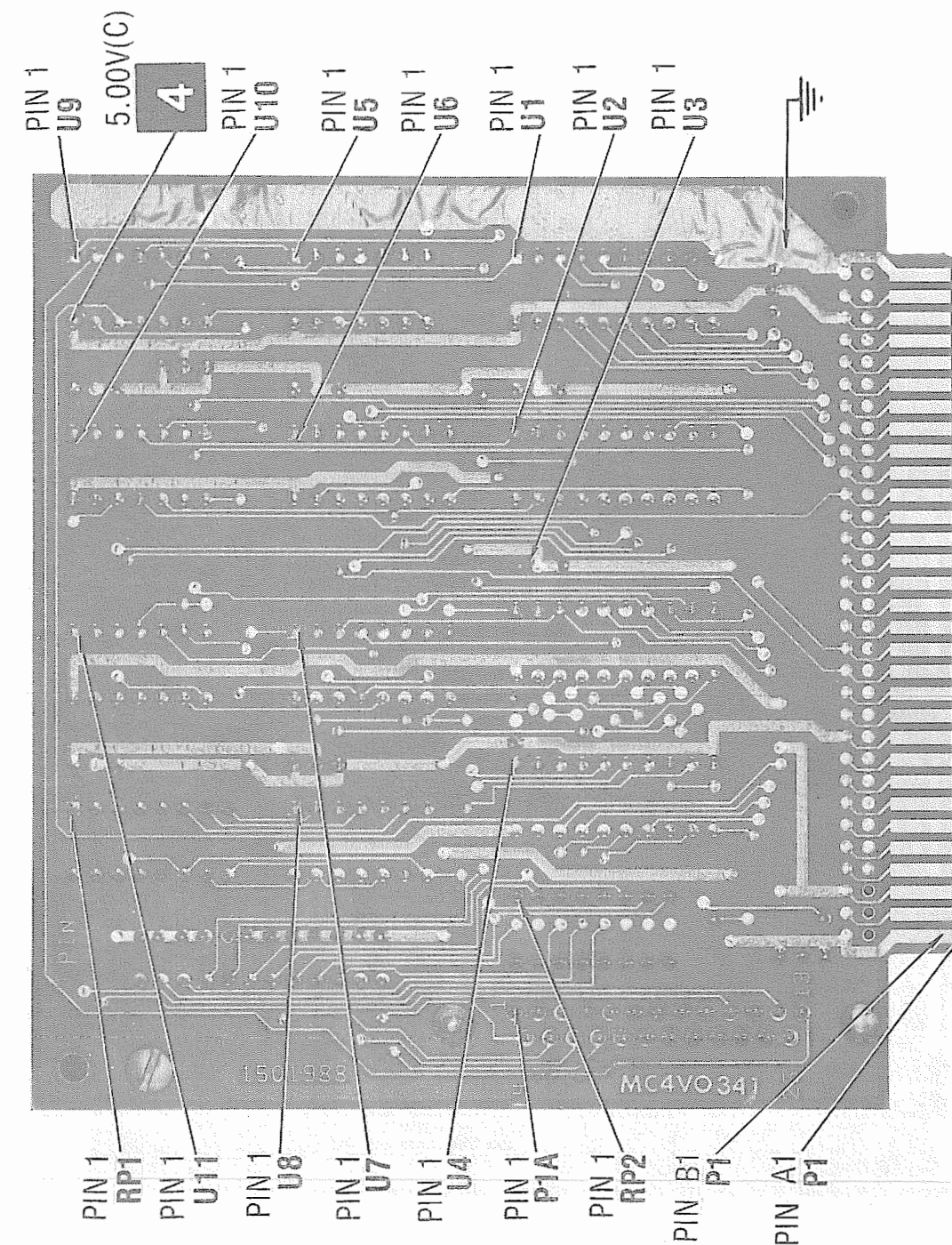
No horizontal sync at either Jack J2 or Jack J1(A). Check for horizontal pulses at pin 9 of IC U42. If the horizontal pulses are present and the logic reading is low at pin 10 of IC U42, check IC U42 by substitution. If the horizontal pulses are missing, check the waveforms at pins 8 and 9 of Flip/Flop IC (U64). If the waveforms are normal, check IC U64 by substitution. If the waveform at pin 9 of IC U64 is missing, check the waveform at pin 6 of Flip/Flop IC (U21). If the waveform is good, check IC U21 by substitution. If the waveform is missing, check CRT Control IC (U38) by substitution.

Horizontal sync is normal at Jack J2, but there is no horizontal or vertical sync at Jack J1(A). Check the waveform at pin 2 of Status Register IC (U24). If the waveform is normal, check Resistor R5 and check IC U24 by substitution. If the waveform is missing, check for pulses at pin 13 of IC U20. If pulses are present, check IC U20 by substitution. If the pulses are missing, check IC U42 by substitution.

COLOR

No color on a Monitor when connected to the RGB Video Jack (J2) but Monitor operates correctly when connected to the composite Video Jack (J1(A)). Check the 3.58MHz waveform at pin 12 of Timing Generator IC (U5). If the waveform is missing, check IC U5 by substitution. If the waveform is good, put the Computer in Basic mode, see the "Basic" section of the General Operating Instructions. Type SCREEN 1 and press the RETURN key. Check for a high logic reading at pins 1 and 10 of Flip/Flop IC (U44) and pin 10 of Flip/Flop IC (U43). If the readings are all low check for a low logic reading at pin 7 of Mode Control IC (U40). If the reading is not low, check ICs U16 and U40 by substitution. If the reading is low, check the waveforms at pins 9 and 10 of Composite Color Generator IC (U45). If the waveforms are missing, check IC U68 by substitution. If the waveforms are normal, check IC U45 by substitution.

If there is no color on a Monitor connected either to Jack J2 or Jack J1(A), check Color Encoder ICs (U9 and U10) and IC U101 by substitution.



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COLOR GRAPHIC MONITOR ADAPTER (Continued)

VIDEO

No video on the Monitor connected to the composite Video Output Jack (J1(A)), but the Monitor connected to the RGB Video Jack (J2) functions. Check the waveform at the base of Composite Color Out (Q1). If the waveform is normal, check Transistor Q1, Resistors R1 and R4 and the connections at Jack J1(A). If the waveform is missing, check the waveform at pin 8 of Status Register IC (U24). If the waveform is normal, check Resistor R8 and check IC U24 by substitution. If the waveform is missing, check the waveforms at pins 1, 2, 3, 9, 10, 13, 14 and 15 of Composite Color Generator IC (U45). If the waveforms are good, check IC U45 by substitution. If the waveform at pin 9 or 10 of IC U45 is missing and the logic reading is low at pin 2 of IC U68, check IC U68 by substitution. If the waveforms at pins 1 and 15 or 2 and 14 of IC U45 are missing and the logic reading is high at pin 1 of Flip/Flop IC (U44), check IC U44 by substitution. If the waveform at pins 3 and 13 of IC U45 is missing and the logic reading is high at pin 10 of Flip/Flop IC (U43), check IC U43 by substitution.

No video on the monitor connected to Jack J2, but the Monitor connected to Jack J1(A) operates. Check the connections at pins 3, 4 and 5 of Jack J2. Check Capacitors C20, C21 and C22 and check IC U67 by substitution.

No video from either Jack J1(A) or Jack J2. Verify that the 14MHz Divider ICs (U4 and U5) are functioning properly by checking the waveforms at pins 2, 5, 7, 10, 12 and 15 of ICs U4 and U5. To verify the CRT Controller IC (U38) is functioning properly, check the logic readings on all the pins as well as the waveforms on pins 16, 18, 21, 39 and 40. Verify that the Video RAM Address Latches ICs (U58 thru U61) are functioning by checking the logic probe readings on all the pins of ICs U58 thru U61.

One or more characters fail to come up properly on the Monitor screen and the character always looks the same regardless of its location. Check the Prom (Character Generator) IC (U33) by substitution. If the characters are wrong only in one location on the Monitor screen, refer to the "Video RAM" section of this Troubleshooting guide.

CURSOR

Monitor screen comes up normally, but the cursor is missing. Check for pulses at pin 19 of CRT Control IC (U38). If the pulses are missing, check IC U38 by substitution. If pulses are present, check for pulses at pin 2 of IC U20. If the pulses are missing, check IC U20 by substitution. If pulses are present, check for pulses at pin 12 of Flip/Flop IC (U21). If the pulses are missing and the waveform at pin 9 of IC U21 is normal, check IC U21 by substitution.

If the cursor is visible but not blinking, check for pulses at pin 6 of Flip/Flop IC (U12). If the pulses are missing, check IC U12 by substitution.

BLINK AND HIGHLIGHT

If the blink and highlight feature does not operate at one or more locations on the Monitor screen, see the "Video RAM" section of this Troubleshooting guide.

If the blink features does not operate, put the computer in Basic mode, see the "Basic" section of the General Operating Instructions. Type in and run the following Basic program which fills the screen with blinking, highlighted characters.

```

1 DEF SEG = &HB800
2 FOR X=0 TO 4000 STEP 2
3 POKE X,42: POKE X + 1, 143
4 NEXT X
5 GOTO 5
    
```

Check for a high logic reading at pin 15 of Mode Control IC (U40). If the reading is not correct, check IC U40 by substitution. If the reading is normal, check for the waveform shown in Figure 1 at pin 2 of Data Latches IC (U35). If the waveform is missing, check U35 by substitution.

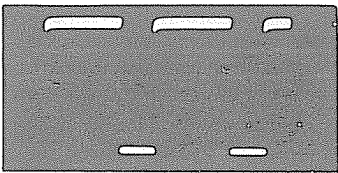


Figure 1

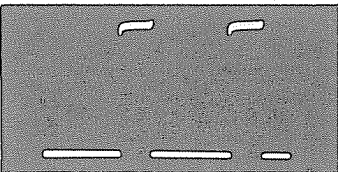
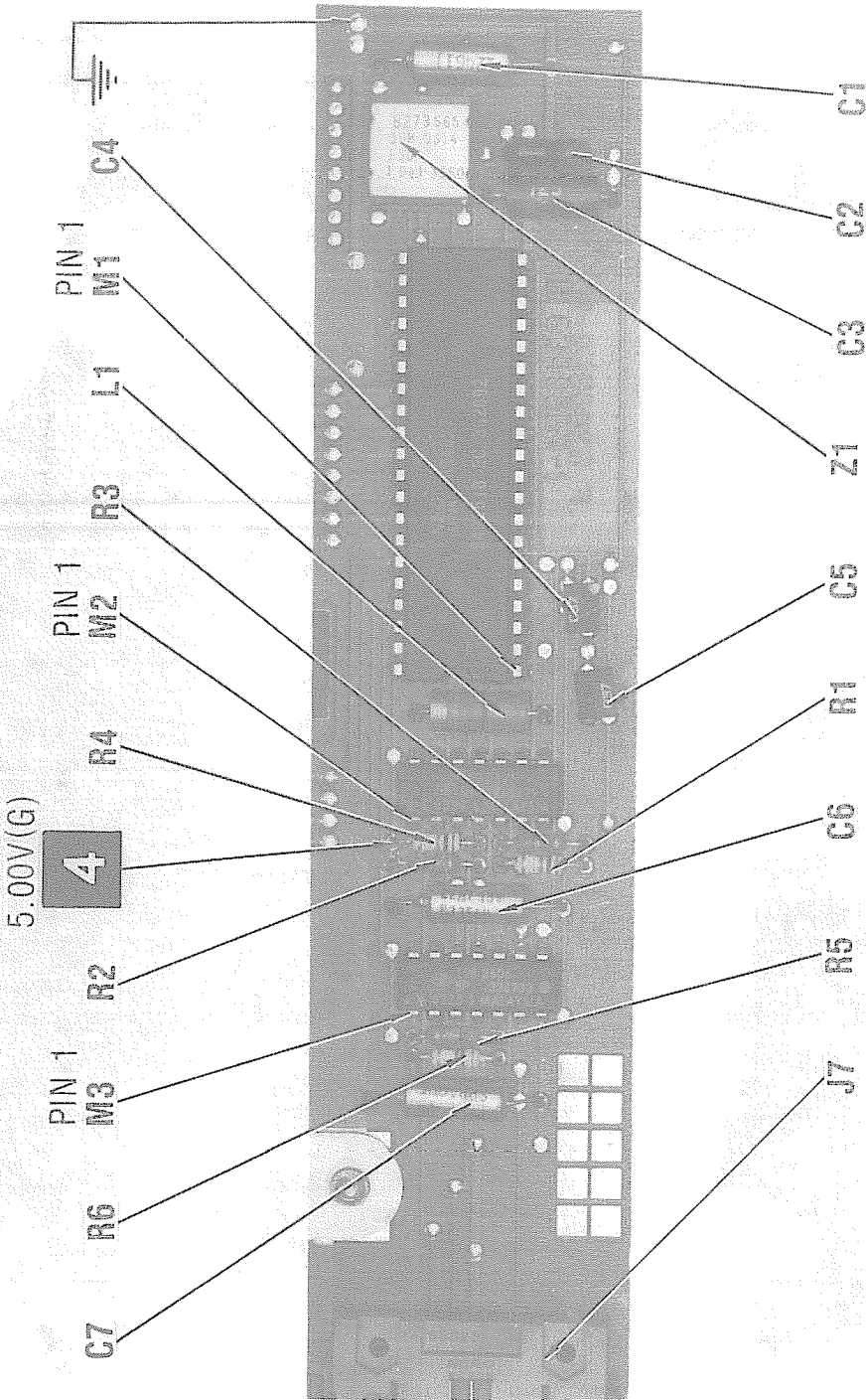


Figure 2

If the waveform is normal, check the waveform shown in Figure 2 at pin 8 of IC U28. If the waveform is missing and the logic reading is high at pin 9 of IC U28, check IC U28 by substitution. If the waveform is normal, check the waveform at pin 3 of IC U14. The waveform should look like Figure 2 and be blinking On and Off. If the waveform is missing and the waveform on pin 2 of IC U14 is normal, check IC U14 by substitution. If the waveform on pin 2 of IC U14 is missing, check Flip/Flop IC (U12) by substitution. If the waveform at pin 3 of IC U14 is good, check IC U13 by substitution.

If the highlight feature is not operating, type in and run the above Basic program and check for the waveform shown in Figure 1 at pin 12 of IC U35. If the waveform is missing, check IC U35 by substitution. If the waveform is good, check for pulses at pin 9 of Color Encoder IC (U10). If pulses are missing, check IC U10 by substitution. If pulses are present, check for pulses at pin 10 of Flip/Flop IC (U101). If pulses are missing, check IC U101 by substitution. If pulses are present, check Resistor R7 and check Status Register IC (U24) by substitution, if the Monitor is connected to the composite Video Output Jack (J(A)) and does not have the highlight feature. Check Capacitor C23 and check IC U67 by substitution if the Monitor is connected to the RGB Video Jack (J2) and does not have the highlight feature.

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TROUBLESHOOTING (Continued)

DISK DRIVES AND ADAPTER

TEST SETUP

Connect a Disk Drive known to be operating properly to the Computer as Disk Drive A. Connect the defective Disk Drive as Disk Drive B. Use Disk Drive A to load any alignment or test program needed to check the defective Disk Drive.

WARNING: It is possible for a defective Disk Drive to write on or erase information on a diskette, even if the diskette is write protected. Check the Disk Drive by first using a diskette that has programs that have been backed up on another diskette. Do not leave the alignment diskette in the drive while checking voltages and waveforms unless specified in the alignment procedures. The test equipment may cause the Disk Drive circuits to erase sections of the alignment diskette even if the diskette is write protected.

DIRECT OPERATION OF DISK DRIVE

The following Basic program will make Disk Drive B run continuously in the read mode with HEAD 0 On. To make Disk Drive A run continuously, in line number 80 change the number 37 (2nd number) to number 20.

```
10 DEF SEG = 0
20 DEF USR = 40000
30 FOR X = 40000 TO 40007
40 READ Y
50 POKE X, Y
60 NEXT X
70 A = USR(0)
80 DATA 176,37,186,242,3,238,235,253
```

DISK DRIVE WILL NOT RUN

Check for 12V at pin 1 of Jack J2 and 5V at pin 4 of Jack J2. If either voltage is missing, check the connector and cable at Jack J2 for good connection. If the voltages are normal, type in and run the Basic program given in the "Direct Operation of Disk Drive" section of this Troubleshooting guide. Check for a low logic reading at pin 16 of Jack J1. If the reading is not low, check for a low logic reading at pin 8 of IC U16 on the Disk Drive Adapter. If the reading is low, check the Disk Drive cable and Connectors P2 and J1. If the reading is not low, check for a high logic reading at pin 9 of IC U16. If the reading is high, check IC U16 by substitution. If the reading at pin 16 of Jack J1 is low, check for a low logic reading at pin 2 of IC 3E. If the reading is not low, check IC 3E by substitution. If the reading is low, check the voltages, waveforms and components associated with Motor Drive Transistors (Q1A and Q2A) and Frequency to Voltage Converter IC (U1) on the Servo Board and check Drive Motor (M2).

HEAD CLEANING

Use a non-abrasive cleaning diskette to clean the heads. If the Disk Drive is a single sided drive, use a single sided cleaning diskette to avoid damaging the head pad.

DISK INDEX DETECTOR

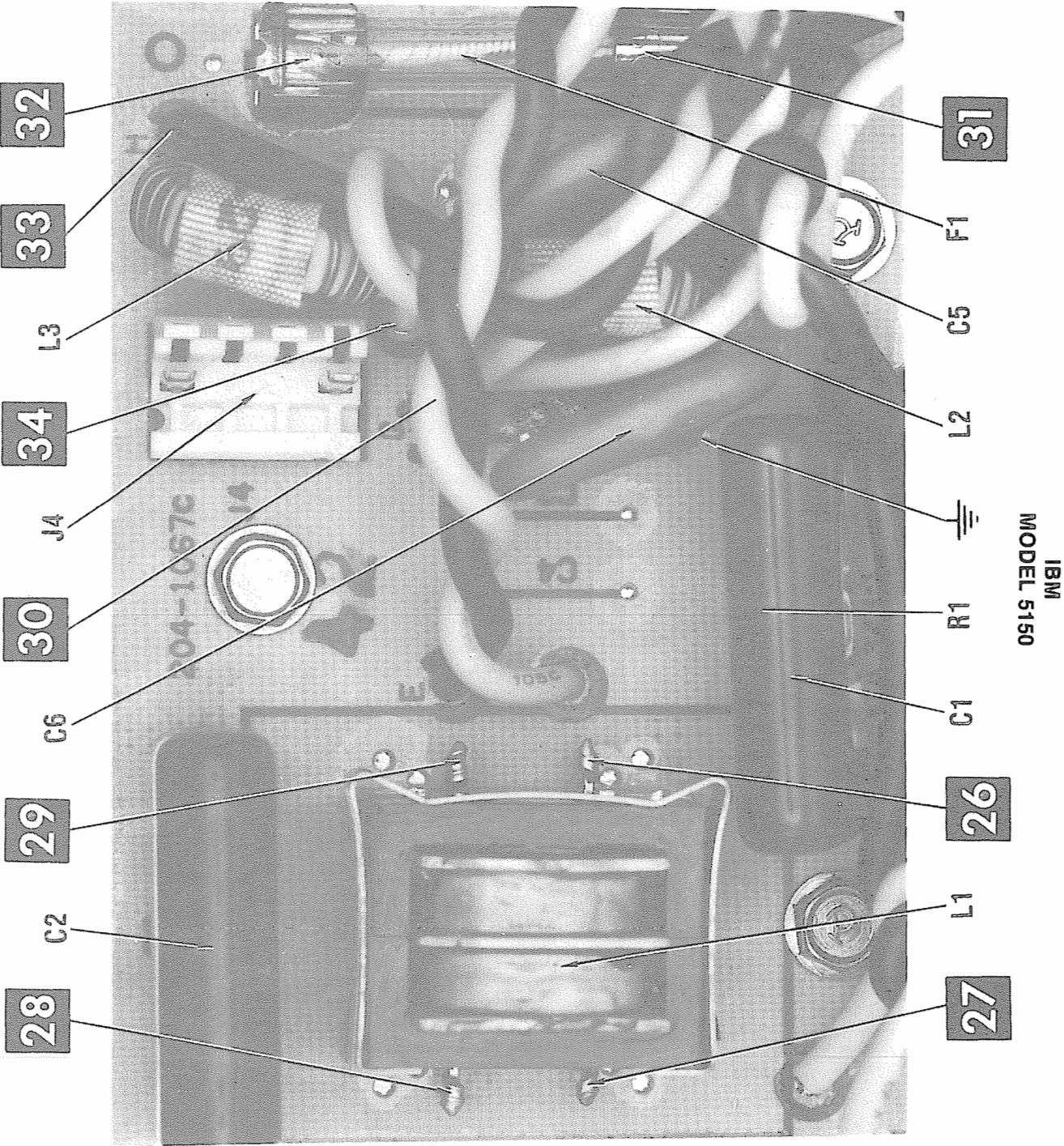
Check for pulses at pin 2 of IC 2E on the Disk Drive Board while the Disk Drive is running with a diskette inserted and door closed. If the pulses are missing, check for pulses at pin 1 of IC 2E. If the pulses are present, check IC 2E by substitution. If the pulses are missing, use a scope to check for .75V peak to peak pulses at the base of Switch Transistor (Q8). If the correct pulses are present, check Transistor Q8, Capacitor C9 and Resistors R44 and R45. If the correct pulses are missing, check the Index Detector Diode (CR26), Amp Transistor (Q11) and the connections at Plug P10.

If pulses are present at pin 2 of IC 2E, check for pulses at pin 3 of IC 1F. If the pulses are missing and pin 2 of IC 1F reads a logic high, check IC 1F by substitution. If pulses are present, check for pulses at pin 2 of Driver IC (U18) on the Disk Drive Adapter. If the pulses are missing, check the cables and connectors going to the Disk Drive Adapter. If pulses are present, check for pulses at pin 18 of IC U18. If the pulses are missing, check IC U18 by substitution. If pulses are present, check Control IC (U6) by substitution.

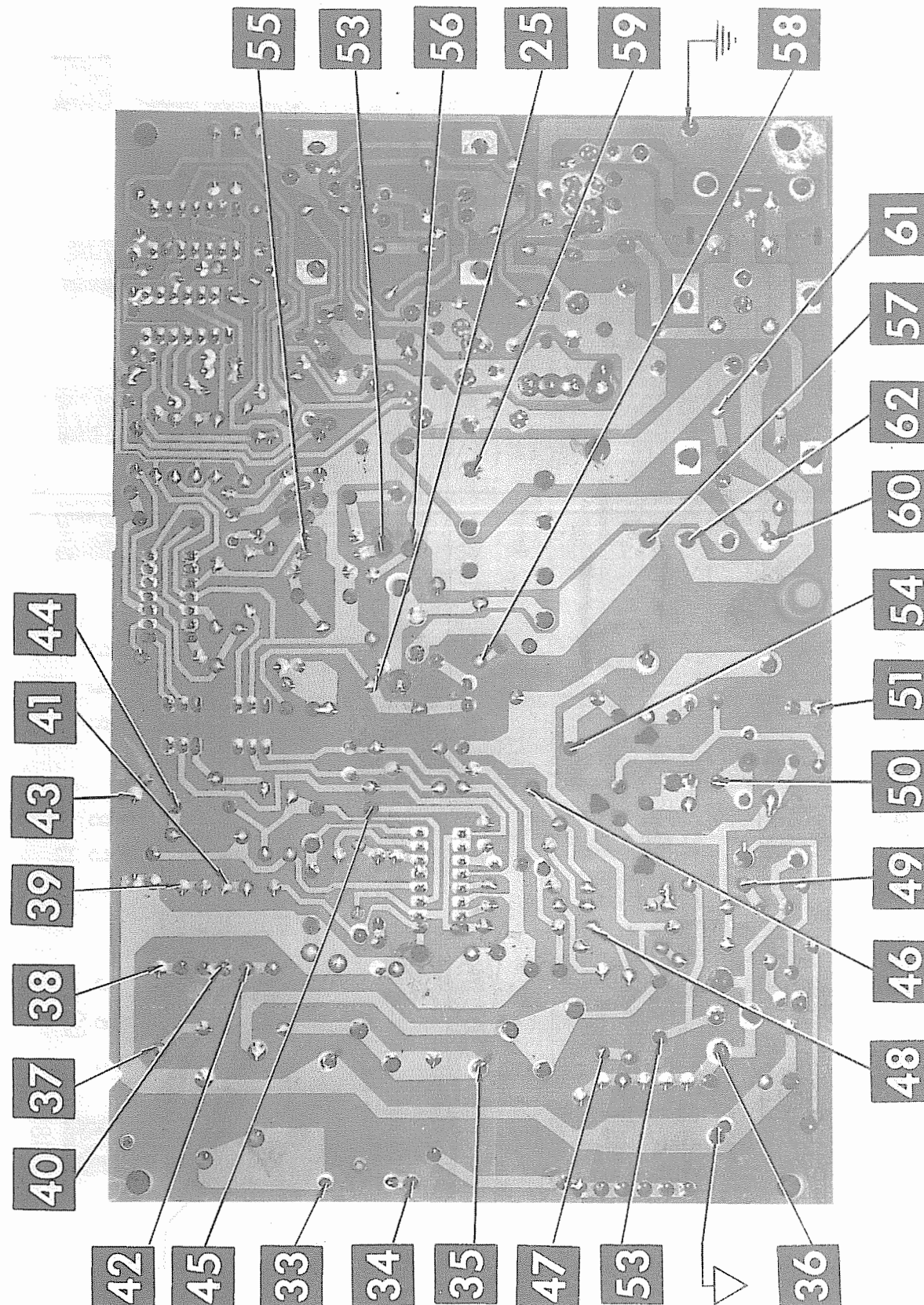
HEAD POSITION MOTOR

Head Position Motor (M1) is not operating properly. Check the resistance readings (73 ohms) on each motor winding and check Plug P12 for good connections. Use a Disk Drive test program which will step the head back and forth or connect the Disk Drive to a Disk Drive Tester that can step the head. Use a test mode that will step the head back and forth continuously and check for pulses at pins 2, 3, 5, and 6 of IC 4D and IC 4E. If the pulses are present at pins 2 and 6 of IC 4D and missing at pins 3 and 5, check IC 4D by substitution and check Diodes CR18 and CR19. If the pulses are present at pins 2 and 6 of IC 4E and missing at pins 3 and 5, check IC 4E by substitution and check Diodes CR20 and CR21. If the pulses are missing at pins 2 and 6 of ICs 4D and 4E, check for pulses at pins 2, 3, 11 and 12 of Flip/Flop IC (4C). If pulses are present and pin 1 of IC 4C reads a logic high, check IC 4C by substitution.

If the pulses are missing at pin 3 of IC 4C, check the logic probe readings on pins 1, 2, 4 and 5 of IC 4B. If the readings are correct, check IC 4B by substitution. If the pulses are missing at pin 5 of IC 4B, check for pulses at pin 11 of IC 2E. If pulses are present, check IC 2E by substitution. If the pulses are missing, check the connectors and cables going to the Disk Drive Adapter. Check for pulses at pin 9 of IC U9 on the Disk Drive Adapter. If pulses are present, check IC U9 by substitution. If the pulses are missing, check for pulses at pins 9 and 10 of IC U4. If pulses are present, check IC U4 by substitution. If the pulses are missing, check Control IC (U6) by substitution.



DISK DRIVES AND ADAPTER (Continued)



WILL NOT READ

Type in and run the program given in the "Direct Operation of Disk Drive" section of this Troubleshooting guide to make the Disk Drive run continuously in the read mode. To verify that the Disk Drive is operating in the read mode, check for a low logic reading at pin 10 of IC 2B.

If the reading at pin 10 of IC 2B is not low, check for a high logic reading at pin 11 of IC 2B. If the reading is high, check IC 2B by substitution. If the reading is not high, check for a low logic reading at pin 13 of IC 3B. If the reading is low and the logic reading is high at pins 9, 10 and 12 of IC 3B, check IC 3B by substitution. If pin 13 of IC 3B does not read low, check for a high logic reading at pin 13 of IC 3D. If the reading is high, check IC 3D by substitution. If the reading is not high, check the cable and connectors going to the Disk Drive Adapter. If the cables and connectors are normal, check for a low logic reading at pin 15 of Driver IC (U7). If the reading is low, check IC U7 by substitution. If the reading is not low, check Control IC (U6) by substitution.

If the reading at pin 10 of IC 2B is low put a diskette into the Disk Drive and close the Disk Drive door. The diskette should be filled with programs to insure that the head will continually read information. Check the waveforms at pins 1 and 14 of Diff Amp IC (4A). If the waveforms are missing, check the voltages and components associated with pins 1, 4, 5, 7, 8, 10, 11 and 14 of Diff Amp IC (3A). Check Diodes CR2, CR3, CR11 and CR12 and the resistance of the heads. A problem in the head switching circuit, Switch Transistors (Q6 and Q8), may affect the read circuits. If the problem appears to be in the head switching circuit, see the "Disk Drive Will Not Switch Sides" section of this Troubleshooting guide. If the waveforms are good at pins 1 and 14 of IC 4A, check the waveforms at pins 2 and 3 of IC 5B. If the waveforms are missing, check the voltages and components associated with pins 4, 5, 7, 8, 10 and 11 of IC 4A. If the waveforms are normal, check the waveform at pin 7 of IC 5B while opening and closing the Disk Drive door. A noticeable shift in the waveform pulses should occur. If no change occurs, check IC 5B by substitution.

NOTE: The waveforms shown at pin 12 of IC 5D and pin 4 of Multivibrator IC (5E) should be present even when the disk drive is not running. If the waveforms are missing, check Capacitor C11 and Resistor R22 and check Multivibrator IC (5C) and ICs 5D and 5E by substitution. If the waveforms are normal, check the waveform at pin 5 of IC 5E. If the waveform is missing and there are pulses at pin 10 of IC 5E, check Capacitors C12 and Resistor R24 and check IC 5E by substitution. If the waveform is present, check for pulses at pin 8 of IC (1F). If the pulses are missing and the logic reading is high at pin 10 of IC 1F, check IC 1F by substitution. If pulses are present, check the cables and connectors going to the Disk Drive Adapter. Check for pulses at pin 12 of Driver IC (U18). If the cable and connectors are good but the pulses are missing at pin 12 of IC U18, check IC U18 by substitution.

WILL NOT WRITE

Verify that the write protect circuit is functioning properly by inserting a diskette that is not write protected into the Disk Drive and check for a high logic reading at pin 10 of IC (3B). If the reading is not high, see the "Write Protect Does Not Function" section of this Troubleshooting guide.

If the write protect circuit is functioning, type and run the Basic program given in the "Erase Head" section of this Troubleshooting guide. Check for pulses at pin 8 of IC 3B. If the pulses are missing, check for pulses at pin 13 of IC 3B and check for high logic readings at pins 9 and 12 of IC 3B. If the readings are correct, check IC 3B by substitution. If the pulses are missing at pin 13 of IC 3B, check for pulses at pin 13 of IC 3D. If pulses are normal, check IC 3D by substitution. If the pulses are missing, check the cable and connectors J1 and P2 which go to the Disk Drive Adapter. Also check for pulses at pin 15 of Driver IC (U7) on the Disk Drive Adapter. If the cable and connectors check normal and the pulses are present, check IC U7 by substitution. If the pulses are missing, check IC U6 by substitution.

If pulses are present at pin 8 of IC 3B, check for pulses at pin 4 of IC 2B. If the pulses are missing, check IC 2B by substitution. If pulses are present, check for pulses at the collector of Switch Transistor (Q3). If the pulses are missing, check the voltages and components associated with Write Amp Transistors (Q1 and Q2) and Transistor Q3. If pulses are normal, check for pulses at pin 12 of IC 2E. If the pulses are missing, check IC 2E by substitution. If pulses are present, check for pulses at pin 6 of IC 2E. If the pulses are missing, check for pulses at pin 5 of IC 2E. If pulses are present, check IC 2E by substitution. If the pulses are missing, check the cables and connectors of J1 and P2 which go to the Disk Drive Adapter. Check for pulses at pin 1 of IC U9 on the Disk Drive Adapter.

If the cable and connectors check normal and pulses are present at pin 1 of IC U9, check IC U9 by substitution. If the pulses are missing, check for pulses at pin 30 of Control IC (U6). If pulses are present, check Flip/Flop IC (U11) by substitution. If the pulses are missing, check IC U6 by substitution.

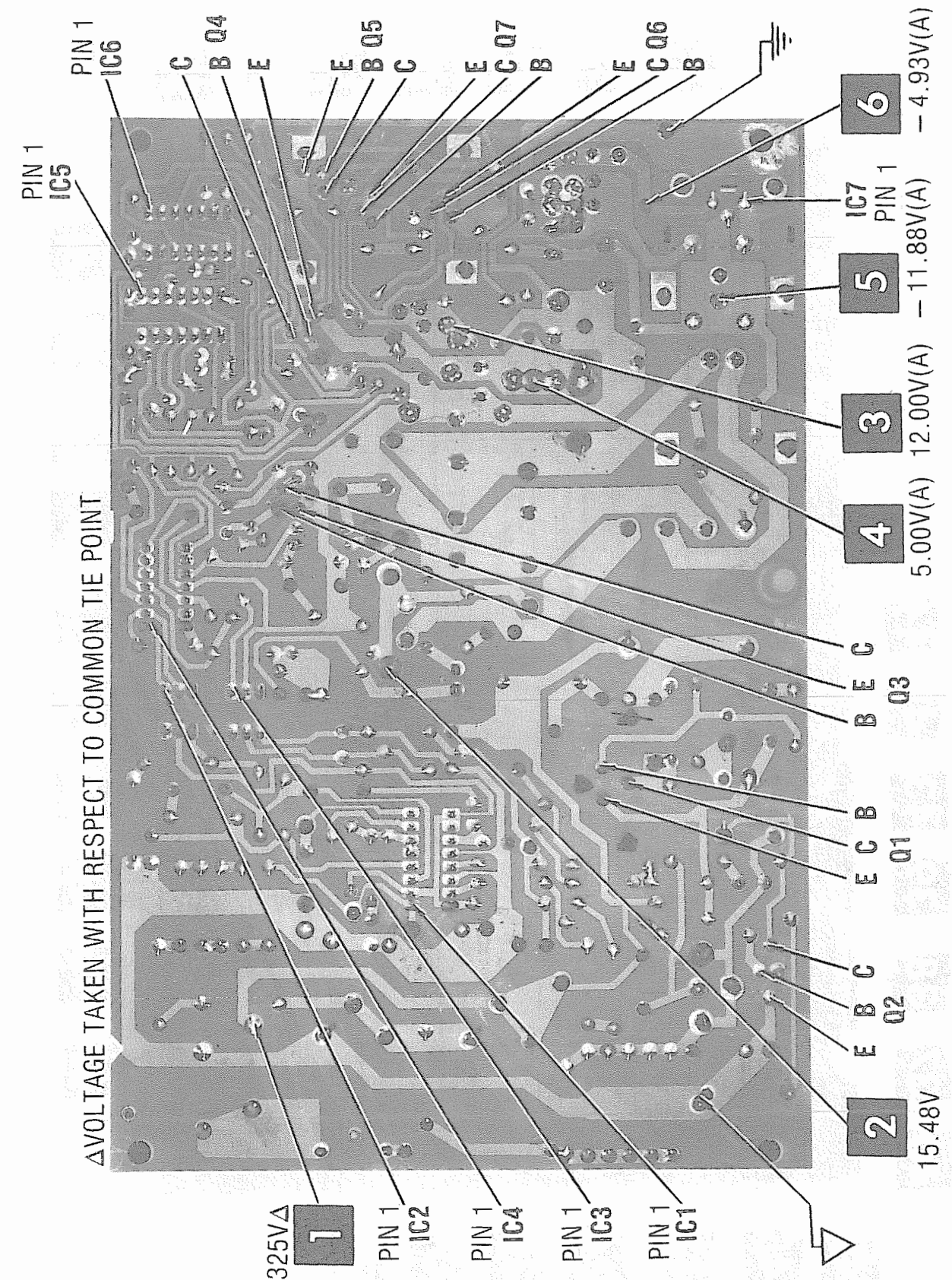
If pulses are present at pin 6 of IC 2E, check for pulses at pins 8 and 9 of Flip/Flop IC (5C). If the pulses are missing, check IC 5C by substitution. If pulses are present, check for pulses at pins 6 and 8 of IC 2B. If the pulses are missing, check IC 2B by substitution. If pulses are normal, check the waveforms at the collectors of Transistors Q1 and Q2. If the waveforms are missing, check the voltages and components associated with Transistors Q1 and Q2. Check the connections at Plugs P5 and P6. Check the resistances of the heads and operation of the Switch Transistors (Q6 and Q7), see the "Disk Drive Will Not Switch Sides" section of this Troubleshooting guide.

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DISK DRIVES AND ADAPTER (Continued)

If a write protected diskette is being written on, insert a write protected diskette into the Disk Drive, close the door, and check for a low logic reading at pin 10 of IC 3B on the Disk Drive Board. If the reading is low, check IC 3B by

NOTE: The diskette used in the Disk Drive must be one that was formatted for double sided use. To verify that the Disk Drive is switching sides, type in and run the Basic program given in the "Erase Head" section of this Troubleshooting guide. Check for pulses at pins 2 and 7 of Jack J3 on the Disk Drive Board. If the pulses are missing, check for pulses at pin 2 of IC 2B and pin 12 of IC 3E. If pulses are present at ICs 2B and 3E, check the voltages and components associated with Switch Transistors (Q6 and Q7). If the pulses are missing at pin 2 of IC 2B, check for pulses at pin 1 of IC 2B. If pulses are present, check IC 2B by substitution. If the pulses are missing at pin 12 of IC 3E and present at pin 13 of IC 3E, check IC 3E by substitution. If the pulses are missing at pin 13 of IC 3E, check for pulses at pin 32 of Jack J1. If pulses are present, check IC 2E by substitution. If the pulses are missing, check for pulses at pin 32 of Plug P2 on the Disk Drive Adapter. If pulses are present, check the cable and connectors. If the pulses are missing, check for pulses at pin 12 of IC U9. If pulses are present, check IC U9 by substitution. If the pulses are missing, check for pulses at pin 27 of Control IC (U6). If pulses are present, check IC U4 by substitution. If pulses are missing, check IC U6 by substitution.

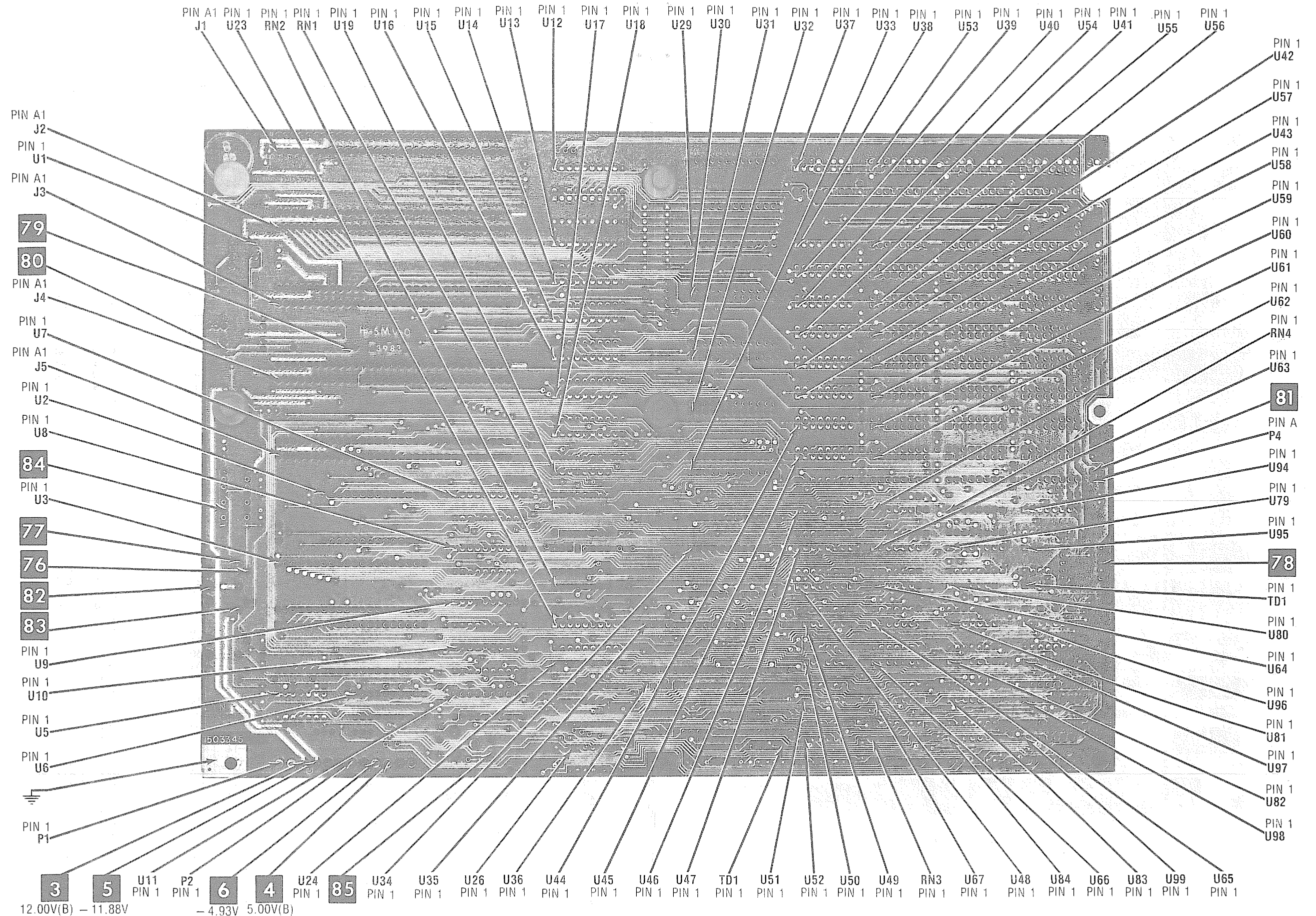


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C3	C-4	C7H	S-23	R11	A-16	U12	P-12	U50	C-19
C3A	I-25	C7J	S-21	R12	A-16	U13	P-12	U51	B-19
C3B	K-25	C7K	S-18	R13	C-9	U14	O-12	U52	A-19
C3C	M-25	C7L	M-14	R14	C-10	U15	N-12	U53	R-21
C3D	O-25	C7M	I-10	R15	A-9	U16	L-12	U54	P-12
C3E	Q-25	C8	M-4	R16	B-7	U17	K-12	U55	O-21
C3F	R-25	C9	E-27	R17	C-3	U18	J-12	U56	N-21
C3G	S-27	C10	D-2	R18	C-7	U19	I-12	U57	M-21
C3H	R-22	C10A	E-2	R19	C-5	U23	E-11	U58	L-21
C3J	R-20	C10C	C-3	R20	N-10	U24	C-12	U59	K-21
C3K	I-22	D1	N-1	R21	C-10	U26	A-12	U60	J-21
C3L	P-22	J1	S-3	R22	A-7	U27	N-14	U61	J-21
C3M	N-22	J2	Q-3	R23	H-27	U29	O-16	U62	H-21
C3N	L-22	J3	O-3	R25	B-8	U30	N-16	U63	G-21
C3P	J-22	J4	L-4	RN1	H-12	U31	L-16	U64	F-21
C3Q	I-20	J5	J-3	RN2	F-12	U32	J-16	U65	D-21
C3R	K-20	J6	F-1	RN3	A-21	U33	I-16	U66	C-21
C3S	M-20	J7	D-1	RN4	H-23	U34	F-16	U67	B-21
C3T	O-20	K1	I-1	SW1	G-12	U35	D-15	U79	G-23
C3U	J-14	P1	A-3	SW2	B-11	U36	B-15	U80	F-23
C3V	H-13	P2	A-6	T1	A-8	U37	R-19	U81	D-23
C3W	O-27	P3A	Q-27	TD1	E-26	U38	P-19	U82	C-23
C3X	L-27	P4	I-27	TD2	A-17	U39	O-19	U83	B-23
C3Y	J-27	R1	N-1	U1	P-2	U40	N-19	U84	A-23
C5	M-27	R2	N-2	U2	H-5	U41	M-19	U94	H-26
C7	B-1	R3	N-2	U3	F-5	U42	L-19	U95	G-25
C7A	B-3	R4	M-2	U5	C-4	U43	K-19	U96	D-26
C7B	B-4	R5	M-2	U6	B-6	U44	J-19	U97	C-26
C7C	B-5	R6	F-27	U7	H-9	U45	I-19	U98	B-26
C7D	A-16	R7	G-27	U8	G-9	U46	H-19	U99	A-26
C7E	B-27	R8	G-27	U9	E-9	U47	G-19	X1	A-10
C7F	I-27	R9	F-27	U10	D-9	U48	F-19		
C7G	S-25	R10	G-27	U11	B-9	U49	E-19		

C1	F-14	C31	H-1	P/J5	E-8	R23	D-11	R56	A-4
C2	D-13	C32	G-4	Q1	G-10	R24	F-11	R57	B-4
C3	H-13	C33	F-3	Q2	J-12	R25	D-9	R58	B-1
C4	H-9	C34	E-4	Q3	C-5	R26	D-10	R59	B-1
C5	I-9	C35	G-2	Q4	C-3	R27	A-9	R60	B-1
C6	I-13	C36	G-3	Q5	C-1	R28	B-7	R61	C-8
C7	F-11	C38	F-7	Q6	E-2	R29	A-8	R62	D-8
C8	D-10	C41	F-8	Q7	D-2	R30	A-5	R63	C-4
C9	A-10	C43	C-9	R1	E-15	R31	D-7	R64	C-4
C10	E-12	C44	C-9	R2	G-11	R32	D-6	R66	G-14
C11	C-11	CR1	B-14	R3	G-12	R33	C-7	R67	G-14
C12	D-12	CR2	B-14	R4	G-12	R34	B-7	R69	B-13
C13	F-12	CR3	F-8	R5	H-14	R35	B-6	R70	A-12
C14	A-11	CR4	H-10	R6	H-14	R36	D-4	R71	A-11
C15	I-11	CR5	H-9	R7	H-14	R37	C-5	R72	B-11
C16	C-6	CR6	E-9	R8	G-14	R38	C-4	R73	B-11
C17	C-7	CR7	A-10	R9	I-13	R39	C-5	R74	B-11
C18	B-6	CR8	C-7	R10	F-9	R40	B-5	R75	C-11
C19	A-6	CR9	E-8	R11	J-9	R41	F-2	R76	I-3
C20	G-2	CR10	I-4	R12	H-11	R42	F-3	R77	H-3
C21	E-5	CR11	I-5	R13	I-14	R43	E-2	T1	I-10
C22	D-5	IC1	E-11	R14	G-11	R44	E-1	T2	I-7
C23	E-6	IC2	A-9	R15	F-10	R45	A-4	TP5	C-10
C24	F-6	IC3	B-9	R16	F-10	R49	E-7	TP6	F-11
C25	J-9	IC4	A-7	R17	C-10	R50	I-4	TP8	C-1
C26	F-4	IC5	A-3	R18	A-10	R51	I-11	TP9	H-1
C27	I-5	IC6	A-2	R19	C-10	R52	B-5	TP10	D-3
C28	F-1	IC7	I-2	R20	A-5	R53	B-5	TP11	I-3
C29	F-4	L1	G-5	R21	D-11	R54	A-3		
C30	G-1	P/J5	D-15	R22	D-11	R55	C-6		

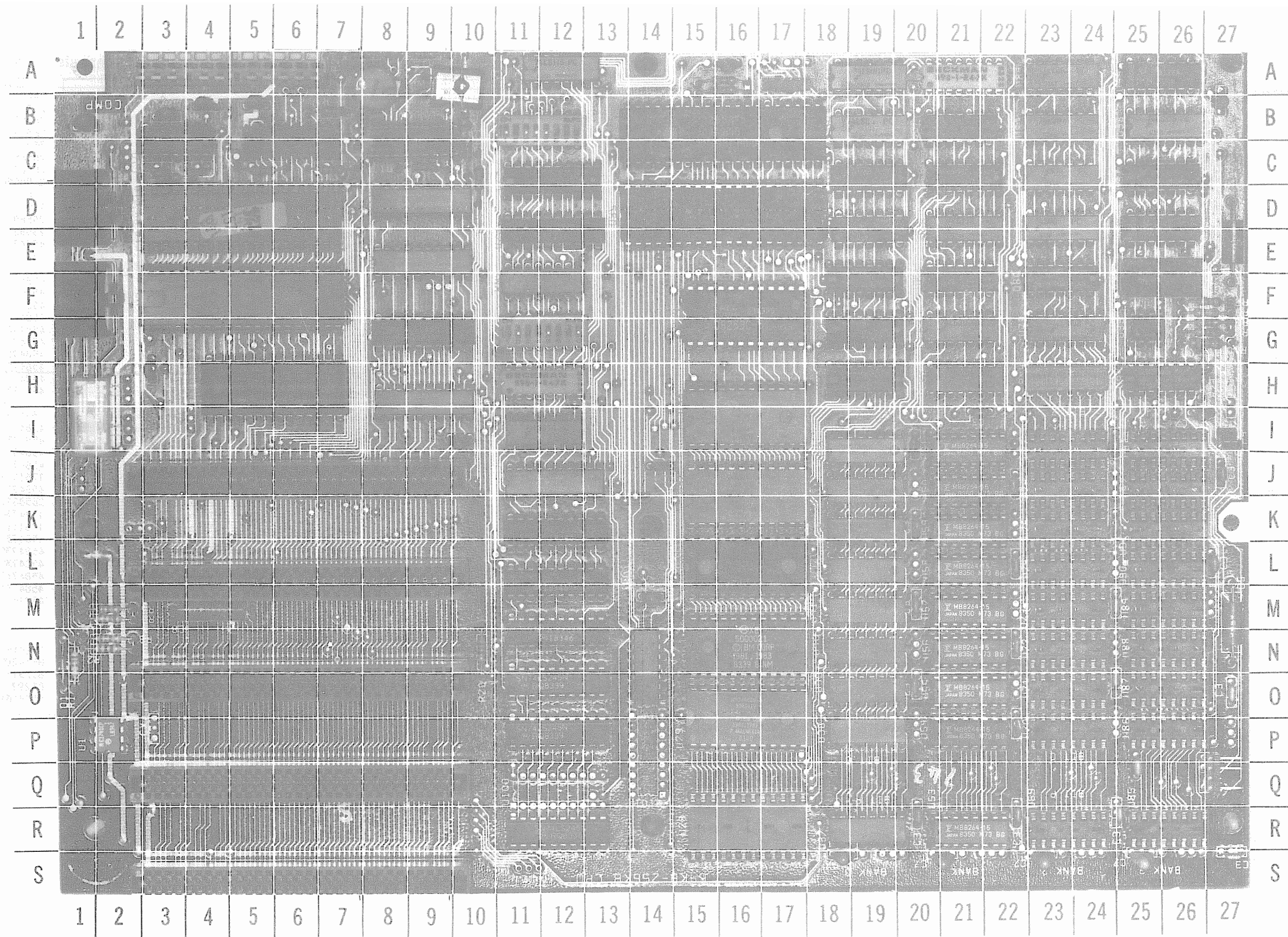


IBM
MODEL 5150

SYSTEM BOARD

A Howard W. Sams CIRCUITAGE® Photo

SYSTEM BOARD



IBM
CSCS2
MODEL 5150

PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS

ITEM No.	TYPE No.	MFGR. PART No.
KEYBOARD TYPE 2		
M1	8340X7	
M2	8048	
M3	239 2122SH	
Z1	158 2606BP	
	IMB 9314 ESD	
POWER SUPPLY		
CR1	G1336	315-6G1336 (1)
CR2	G1340	315-6G1340 (1)
CR3	G1328B	344-07G1328B (1)
CR4	G1336C	287G1336C (1)
CR5	G13370	347-03G13370 (1)
CR6,7	142	
CR8	279-13335	
CR9	G1333B	345-02G1333B (1)
CR10	343-02	735 339(1)
CR11	G1328B	344-02G1328B (1)
CR12	279-11 (C44)	
IC1	221-233	
IC2,3	162-18-0	
IC4	221-129A-01	
IC5,6	221-121B-01	
IC7	221-192-01	
Q1	1086-1	584342(1)
Q2	1014	
Q3	340 975	
Q4	973 339	
Q5,6	340 975	
Q7	992-1	548342(1)
PRINTER ADAPTER		
U1	74LS245PC	
U2	74LS240PC	
U3	SN74LS244N	
U4	SN74LS374N	
U5	SN74LS30N	
U6	DM74LS155N	
U7	74LS174PC	
U8	7405PC	
U9	SN74LS02N	
U10	74LS125APC	
U11	74LS86PC	
SYSTEM BOARD		
D1	1N659 FC	

ITEM No.	TYPE No.	MFGR. PART No.
U1	MC1741CP	
U2	MC1741	
	P8259A	
	8259A	
U3	P8088	(3)
U4	8087	(3)
U5	SN74LS30N	
U6	D8288	
U7	74LS373PC	
U8	SN74LS245N	
U9,10	74LS373PC	
U11	UPB8284AD	
	8284A	
U12 thru U14	SN74LS245N	
U15 thru U17	SN74LS244N	
U18	74LS373PC	
U19	74LS670PC	
U23	SN74LS244N	
U24	SN74LS322AN	
U26	74LS175PC	
U27	74LS02PC	
U29	5000017	MK36A68N-4
	5700019	MK36748N (1)(2)
U30	XE5000021	(1)
	5700027	(2)
U31	XE5000022	
	5700035	MK36905N-4 (1)(2)
U32	5000023	MK36A71N-4 (1)
	5700043	(2)
U33	1501476	MK36C35N-4 (1)
	5700671	MK36887N-4 (1)(2)
U34	D8253C-5	
	8253-5	
U35	D8237A-5	
	D8237AS	
U36	P8255A-5	
	8255A-5	
U37	MK4564N-20	(2)
	MK4116J-44GP	
U38 thru U40	MK4564N-15	(2)
	MK4116J-44GP	
U41	MK4564N-20	(2)
	MK41116J-44GP	

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

CABINET & CABINET PARTS (When ordering specify model, chassis & color)

ITEM	PART No.
KEYBOARD TYPE 2	
Cover Assembly (Top)	8529170
Base Assembly (Bottom)	8529169
Keyboard Assembly	8529166
Adjustable Foot	8529157
Key Button- Esc	4584714
Key Button- / /	1761460
Key Button- @/2	1642308
Key Button- #/3	1642309
Key Button- \$/4	1642342
Key Button- %/5	1642343
Key Button- ^/6	4496183
Key Button- &/7	2658824
Key Button- */8	2658825
Key Button- (/9	2658826
Key Button- / 0	2658827
Key Button- -/+	1761515
Key Button- +/=	2658829
Key Button- +	1643315
Key Button- - -	1643316
Key Button- q	2658832
Key Button- w	2658833
Key Button- e	2658834
Key Button- r	2658835
Key Button- t	2658836
Key Button- y	2658837
Key Button- u	2658838
Key Button- i	2658839
Key Button- o	2658840
Key Button- p	2658841
Key Button- { /	4585286
Key Button- } /	4585288
Key Button- <	5184235
Key Button- CTRL	4584717
Key Button- a	2658846
Key Button- s	2658847
Key Button- d	2658848
Key Button- f	2658849
Key Button- g	2658850
Key Button- h	2658851
Key Button- j	2658852
Key Button- k	2658853
Key Button- l	2658854
Key Button- ;/:	2658855
Key Button- " /,	4584779
Key Button- ~ /`	1642306
Key Button- ^	2658858
Key Button- !/`	5997221

Key Button Identification and Part Numbers obtained from the IBM Hardware Maintenance and Service Manual (Part Number 6025072) Courtesy of IBM

ITEM	PART No.
Key Button- z	2658860
Key Button- x	2658861
Key Button- c	2658862
Key Button- v	2658863
Key Button- b	2658864
Key Button- n	2658865
Key Button- m	2658866
Key Button- < /,	1864026
Key Button- > /,	1864027
Key Button- ? /	2658869
Key Button- PrtSc	2658870
Key Button- Alt	4584718
Key Button- SPACE BAR	1643330
Key Button- Caps Lock	4584719
Key Button- F1	4584720
Key Button- F2	4584721
Key Button- F3	4584722
Key Button- F4	4584723
Key Button- F5	4584724
Key Button- F6	4584725
Key Button- F7	4584726
Key Button- F8	4584727
Key Button- F9	4584728
Key Button- F10	4584729
Key Button- Num Lock	4584730
Key Button- Scroll Lock	4584731
Key Button- 7/Home	4584732
Key Button- 8/↑	4584733
Key Button- 9/Pg Up	4584734
Key Button- -	1761511
Key Button- 4/←	4584735
Key Button- 5	2658892
Key Button- 6/→	4584736
Key Button- +	1761513
Key Button- 1/End	4584737
Key Button- 2/↓	4584739
Key Button- 3/Pg Dn	4584738
Key Button- 0/Ins	4584740
Key Button- . /Del	4584741
Key Buttons- Complete Set	4584657
SYSTEM UNIT	
Bezel Assembly	8529163
Top Cover (No Bezel)	8654209
Cover Assembly	8529162
Disk Cover Plate	8529204
Base Assembly	8529161

IBM
MODEL 5150

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

FUSE DEVICES

ITEM NO.	DESCRIPTION	MFGR. PART NO.		NOTES
		DEVICE	HOLDER	
F1	AC INPUT BOARD 2A @ 250V Slow Blow			

SPEAKER

ITEM No.	TYPE	REPLACEMENT DATA		NOTES
		MFGR. PART No.	QUAM PART No.	
SP	2" PM 8 Ohms	8529143		

Part Numbers obtained from the IBM
Hardware Maintenance and Service Manual
(Part Number 6025072)
Courtesy of IBM

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
M1 P1 S1	CHASSIS Motor Power Cord Switch Power Supply Adapter Adapter Adapter Adapter Adapter Module Module Option Option Option System Board System Board System Board KEYBOARD TYPE 2 Keyboard SYSTEM BOARD	 8529158 8529155 8529150 8529296 8529151 8529149 8529295 8529142 8529211 8529144 8529145 8529212 8529205 8529238 8654213	 Fan AC Power Asynchronous Communications Binary Synchronous Communications Game Control Printer Synchronous Data Link Control Communications 16K Memory 64K Memory 32K Memory Expansion 64K Memory Expansion 64K/256K Memory Expansion (Without 64K Memory Modules) 16K - 64K CPU 16K - 64K CPU (With 64K Installed) 64K - 256K CPU Capactive Matrix Cassette Data In RAM Select 14.31818MHz
K1 SW1 SW2 TD1 TD2 X1	Relay Switch Switch Time Delay Time Delay Crystal		

Part Numbers obtained from the IBM
Hardware Maintenance and Service Manual
(Part Number 6025072)
Courtesy of IBM

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS (cont)

ITEM No.	TYPE No.	MFGR. PART No.
SYSTEM BOARD (Continued)		
U42	MK4564N-15 MK4116J-44GP	(2)
U43	MK4564N-20 MK4116J-44GP	(2)
U44	MK4564N-15 MK4116J-44GP	(2)
U45	MK4564N-20 MK4116J-44GP	(2)
U46 thru U48	SN74LS138N	
U49 U50 U51 U52 U53 thru U61	DM74S08N SN74LS02N 74LS04PC 74LS00PC MK4564N-20 MK4116N-44GP	(2)
U62 U63 U64	74LS158PC 74LS38PC SN74LS20N	

(1) Number on unit.
(2) Used In 16K/64K System Board.
(3) IBM Part Number 8529147 Includes U3 and U4.
Part Numbers obtained from the IBM
Hardware Maintenance and Service Manual
(Part Number 6025072)
Courtesy of IBM

ELECTROLYTIC CAPACITORS

Item numbers not listed are normally available at local distributors.

ITEM No.	RATING	MFGR. PART No.
KEYBOARD TYPE 2		
C1 C6 C7	56 6V 10% 22 15 10% 56 6V 10%	
PRINTER ADAPTER		
C1 C5 C7 C8	10 16V 10% (1) 10 16V 10% 10 16V 10% 10 16V 10%	

(1) 8.2 may be used In some versions.

ITEM No.	TYPE No.	MFGR. PART No.
U65 U66 U67	74S138PC SN74LS138N DM74LS74AN	
U69 thru U77 U79 U80 U81	MK4116N-44GP 74LS158PC SN74LS125AN 74S00PC	(2)
U82 U83 U84 U85 thru U93 U94	74S74PC 74LS04PC 74LS10PC MK4116N-44GP SN74S280N	(2)
U95	2979DRAEB 75477	
U96 U97 U98 U99	DM74LS74AN DM74S08N 74LS175PC DM74LS04N	

CSCS2
IBM
MODEL 5150

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

CAPACITORS Item numbers not listed are normally available at local distributors.

ITEM No.	RATING	MFGR. PART No.
C1 C2	AC INPUT BOARD .1 125VAC .1 125VAC	

ITEM No.	RATING	MFGR. PART No.
C2 C4 C5	KEYBOARD TYPE 2 50 300V 2% 20.7 20.7	814 037 A341(1) 814 037 A341(1)
T1	SYSTEM BOARD 5-30 Trimmer	

(1) Number on unit.

CONTROLS (All wattages 1/2 watt, or less, unless listed)

ITEM NO.	FUNCTION	RESISTANCE	MFGR. PART NO.	NOTES
R32	POWER BOARD B+ Adjust	1800		

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA	
		MFGR. PART No.	NOTES
R1 R9 R20 R21 R30 R39 R40 R41 R42 R52 R53 R54 R56 R57 R58 R59 R60 R63 R64	POWER BOARD 2 5% 5W WW 100K 5% 5W WW 13.7K 1% 1/4W Carbon Film 21K 1% 1/4W Carbon Film 16.2K 1% 1/4W Carbon Film 25.5K 1% 1/4W Metal Oxide 13.7K 1% 1/4W Carbon Film 392 1% 1/4W Carbon Film 432 1% 1/4W Carbon Film 13.7K 1% 1/4W Carbon Film 17.8K 1% 1/4W Carbon Film 14K 1% 1/4W Carbon Film 17.4K 1% 1/4W Carbon Film 100K 1% 1/4W Carbon Film 41.2K 1% 1/4W Carbon Film 17.4K 1% 1/4W Carbon Film 14.7K 1% 1/4W Carbon Film 66.5K 1% 1/4W Carbon Film 18.7K 1% 1/4W Metal Oxide	63-10442-31(2)	

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

RESISTORS (Power and Special)(cont)

ITEM No.	RATING	REPLACEMENT DATA	
		MFGR. PART No.	NOTES
RP1 RP2	PRINTER ADAPTER Resistor Network (1) Resistor Network (4)	898-1-R4.7K(2) 316B300(2) Q5500303(2)	
RN1 RN2	SYSTEM BOARD Resistor Network (1) Resistor Network (3)	898-1-R4.7K(2) 316A822(2) Q55820008(2)	
RN3 RN4	Resistor Network (1) Resistor Network (4)	898-1-R4.7K(2) 316B300(2) Q5500303(2)	

- (1) Contains fifteen 4700.
(2) Number on unit.
(3) Contains fifteen 8200.
(4) Contains eight 30.

COILS (RF-IF)

ITEM No.	FUNCTION	MFGR. PART No.	ITEM No.	FUNCTION	MFGR. PART No.
L1 L2 L3	AC INPUT BOARD AC Line Choke RF Choke RF Choke		L1	KEYBOARD TYPE 2 Peaking (47uH)	
			L1	POWER BOARD RF Choke	

COILS & TRANSFORMERS (Sweep Circuits)

ITEM No.	FUNCTION	REPLACEMENT DATA		
		MFGR. PART No.	OTHER IDENTIFICATION	NOTES
T1 T2	POWER BOARD Oscillator Pulse		95-3560(1) 95-3555(1)	

(1) Number on unit.

PRELIMINARY SERVICE CHECKS

This data provides the user with a time-saving service tool which is designed for quick isolation and repair of Computer system malfunctions.

Check all interconnecting cables for good connection and correct hook-up before making service checks.

Disconnect all external peripherals from the Computer system to eliminate possible external malfunctions.

Replacement or repair of the Power Supply, System Board, Keyboard, Color Graphic Monitor Adapter, Monochrome Monitor/Printer Adapter, Disk Drive Adapter, Printer Adapter, Disk Drives or connectors may be necessary after the malfunction has been isolated.

DISASSEMBLY INSTRUCTIONS

MAIN SYSTEM UNIT

Remove five screws from rear of cabinet. Slide cabinet forward and remove from unit.

POWER SUPPLY REMOVAL

Disconnect Connectors P8 and P9 from System Board and connectors P10 and P11 from Disk Drives. Remove four screws from rear of the Power Supply cabinet. Push Power Supply forward about 1/2 inch to clear mounting tabs on cabinet bottom and lift Power Supply from unit.

DISK DRIVE REMOVAL

Disconnect two Disk Drive Adapter connectors, one from the rear of each Disk Drive. Disconnect Power Supply Connectors P10 and P11 from the rear of the Disk Drives. Remove two screws from the side of Disk Drive A and slide Disk Drive out the front of cabinet.

SYSTEM BOARD REMOVAL

Remove all Adapter boards from expansion slots. Disconnect Disk Drive connectors and Power Supply connectors from System Board. Disconnect speaker connectors. Remove two screws holding System Board to cabinet bottom. Slide System Board to the left to release plastic stand-offs from mounting slots on cabinet bottom. Lift system board from unit.

KEYBOARD

Lay Keyboard facedown and remove two screws holding lower case. Lift lower case up and out of front retaining slots. Keyboard assembly may now be removed from upper case. NOTE: Do Not attempt to disassemble Keyboard switch assembly. The key caps may be removed one at a time, by lifting up on the cap from the top of the Keyboard.

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PRELIMINARY SERVICE CHECKS (Continued)

ADJUSTMENTS

POWER BOARD

B + ADJUSTMENT

NOTE: The Power Supply **must** be connected to the computer to make this adjustment. Connect a DC voltmeter to pin 8 of IC IC4. Adjust B + Adjust Control (R32) for 5.00V.

SYSTEM BOARD

COLOR ADJUST

Connect the Input of a frequency counter to pin 12 of the Clock Generator IC (U11). Adjust the Color Adjust Trimmer (T1) for a frequency of 14.31818MHz.

DISK DRIVES (A & B) TYPE 1

HEAD CLEANING

Use a non-abrasive cleaning diskette to clean the heads. If the Disk Drive is a single sided drive, use a single sided cleaning diskette to avoid damaging the head pad.

PRELIMINARY SERVICE CHECKS (Continued)

PREVENTATIVE MAINTENANCE

ENVIRONMENT

Computers perform best in a clean, cool area that is below 80 degrees Fahrenheit and free of dust and smoke particles. Even though home Computers are not affected by cigarette smoke as much as commercial Computers are affected, it is better to maintain a smoke-free area around the Computer. Do not block cabinet vents of any of the Computer system; Computer, Monitor, Printer, or other power devices.

ELECTRICAL POWER

Variations in the line voltage can affect the Computer. Try to avoid these fluctuations by using an AC receptacle that is on a power line not used by appliances or other heavy current demand devices. A power-surge protector, power-line conditioner, or non-interruptable power supply may be needed to cure the problem. **Do not** switch power On and Off frequently.

KEYBOARD

Liquids spilled into the Keyboard can ruin it. Immediately after a spill occurs, disconnect the Computer power plug from AC power outlet. Then, if circuitry or contacts are contaminated, disassemble the Keyboard and carefully rinse the Keyboard printed circuit board with distilled water and let it dry. Use a cotton swab to clean between keys. Use a non-abrasive contact cleaner and lint-free wipers on accessible connectors and contacts.

DISK DRIVES

Clean the read/write heads of the Disk Drives about once a month or after 100 hours usage. Use only an approved head cleaning kit.

Handle carefully to preserve proper disk head alignment. A sudden bump or jolt to the Disk Drives can knock the disk head out of alignment. If the Disk Drives must be transported, place an old disk in slot during transport.

Store disks in their protective covers and never touch the disk surface. Observe the disk handling precautions usually found on the back of disk protective covers.

PRINTERS

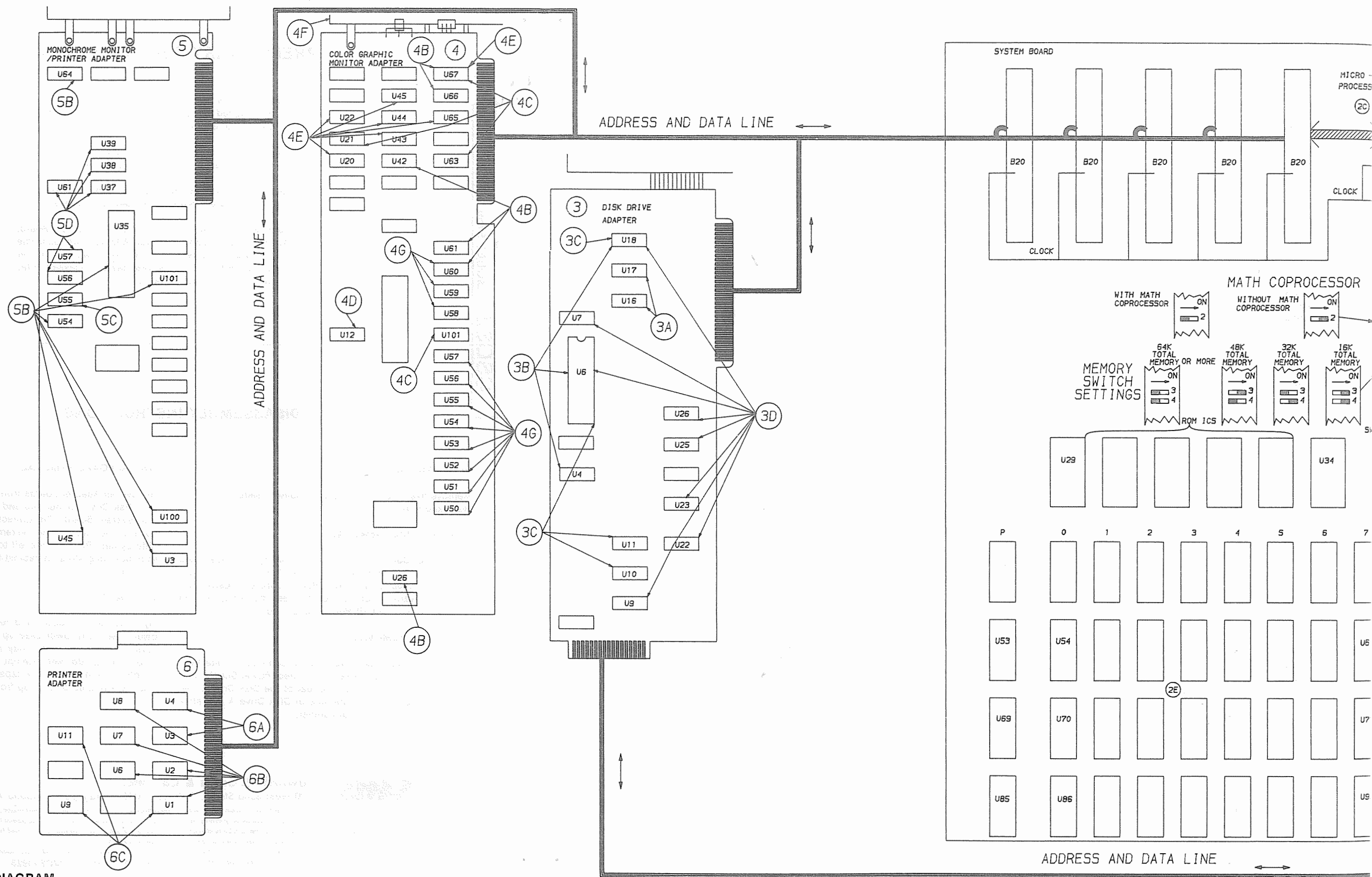
Carefully vacuum the Printer regularly. Wipe surface areas clean using a light all-purpose cleaner. Do not oil the machine. The oil will collect abrasive grit and dust. The dust will act as a blanket. This can cause components to overheat and fail.

STATIC ELECTRICITY

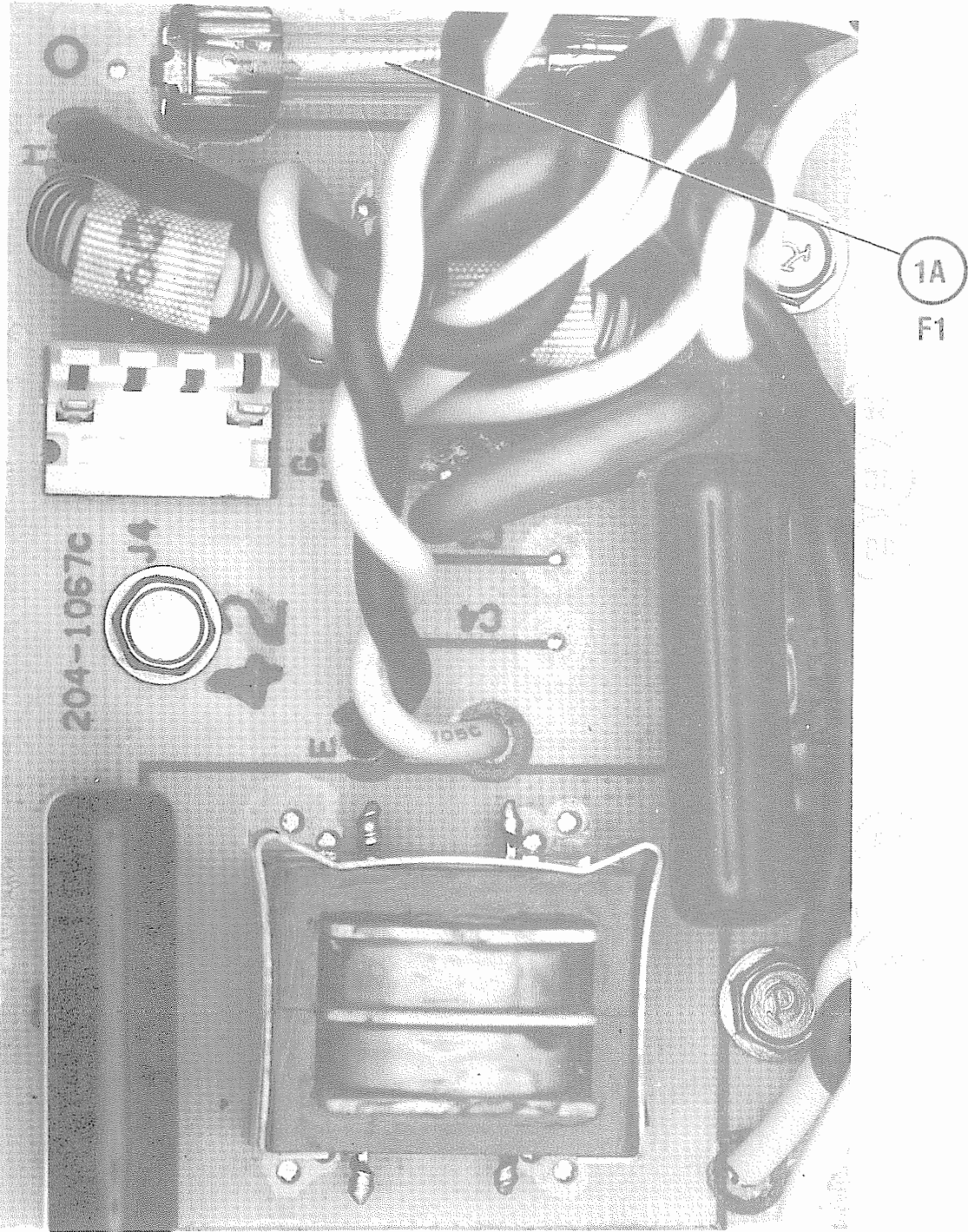
Static electricity discharge can affect the Computer. In order to minimize the possibility, use anti-static mats, sprays, tools and materials, and maintain good humidity in the Computer environment.

MONITOR

Use an isolation transformer with any Monitor that does not come as part of the system since some Monitors use a HOT chassis (chassis connected to one side of the AC line). The face of the Monitor should never be left on for long periods of time at high brightness level except when pattern is being changed periodically. Use caution when cleaning anti-glare screens, to preserve the glare-reduction feature.



INTERCONNECTING DIAGRAM



POWER SUPPLY

GENERAL OPERATING INSTRUCTIONS

POWER ON TEST

A Power On test is automatically performed each time the Computer is turned On. Several diagnostic tests are performed and if a problem is detected, an error code will be momentarily displayed on the Monitor screen. For an explanation of the various error codes, see the "Computer Self-Test" section of the General Operating Instructions.

BOOT UP

Insert a bootable diskette into Disk Drive A and turn On the Computer. The Computer will automatically boot up using the diskette in Disk Drive A. If a PC DOS (Personal Computer Disk Operating System) diskette is used, the Computer will display the date and time and ask for a new date and time. After the date and time have been entered, the version of DOS will be displayed on the Monitor screen along with an A> which indicates the DOS is running.

PC DOS

For a list of file names on the diskette in the current Disk Drive, type DIR and press the ENTER key. To specify Disk Drive that is not current (default), use DIR A: for Disk Drive A or DIR B: for Disk Drive B.

To return to PC DOS from Basic, type SYSTEM and press the ENTER key.

To load a (System) program from a diskette while in DOS, type the program name and press the ENTER key.

A blank diskette must be formatted before it can be used to save information which is in memory. A formatted diskette must contain a DOS or a Start-up program before the Computer will boot up using that diskette.

Insert a diskette containing a "Format Program" into Disk Drive A. Type FORMAT and press the ENTER key. Follow the instructions on the Monitor screen to format the unformatted diskette. NOTE: Formatting a diskette will wipe out any programs previously placed on the diskette. The Computer automatically defaults to Disk Drive A if the destination Disk Drive is not specified. Be sure to specify the destination Disk Drive of the diskette to be formatted or the original diskette may be ruined by the default action.

BASIC

When turned On, the Computer will come up in Cassette (ROM) Basic if there is not a bootable DOS diskette in Disk

Drive A. The version of Basic and memory available will appear at the top of the screen. For additional information on Cassette I/O operations see the "Cassette Operation" section of the General Operating Instructions.

The manufacturer also supplies Disk Basic as well as Advanced Disk Basic on diskette. To load either Disk Basic, first boot up DOS. Insert a diskette with Disk Basic or Advanced Disk Basic program on it. Type BASIC and press the RETURN key to load disk Basic or type BASICA and press the ENTER key to load Advanced Disk Basic. To return to DOS from Basic, type SYSTEM and press the ENTER key.

To view a list and the names of programs on a diskette in the current Drive, type FILES and press the ENTER key. Type FILES "B: *.*" and press the ENTER key to list programs from Disk Drive B. Type FILES "A: *.*" to list programs from Disk Drive A if it is not the current (default) drive.

To load a program in Disk Basic or Advanced Disk Basic from the diskette, type LOAD, the program name enclosed in quotes, and press the ENTER key.

To save a program, type SAVE, the program name enclosed in quotes and press the ENTER key.

To run a program from any Basic mode, type RUN and press the ENTER key. To stop a program, press the CTRL and BREAK (SCROLL LOCK) keys at the same time. NOTE: Some programs will disable or not recognize the CTRL and BREAK keys to prevent the user stopping the program while it is running.

RESETTING COMPUTER

Press the CTRL, ALT, and DEL keys, all three at the same time, to reset the Computer.

CASSETTE OPERATION

To load a program from tape while in Cassette (ROM) Basic, type LOAD, the program name enclosed in quotes and press the ENTER key.

To save a program, type SAVE, the program name enclosed in quotes and press the ENTER key.

To load or save a program from and to tape while in any Disk Basic, type LOAD or SAVE. Then, enclosed in quotes, type CAS1: and the program name, and press the ENTER key. Example: SAVE "CAS1: program name"



GENERAL OPERATING INSTRUCTIONS (Continued)

COMPUTER SELF-TEST

The Computer performs a self-test every time it is turned On. If no problems are detected, the Computer will beep once and (if there is no diskette in the Disk Drive) come up in Cassette (ROM) Basic.

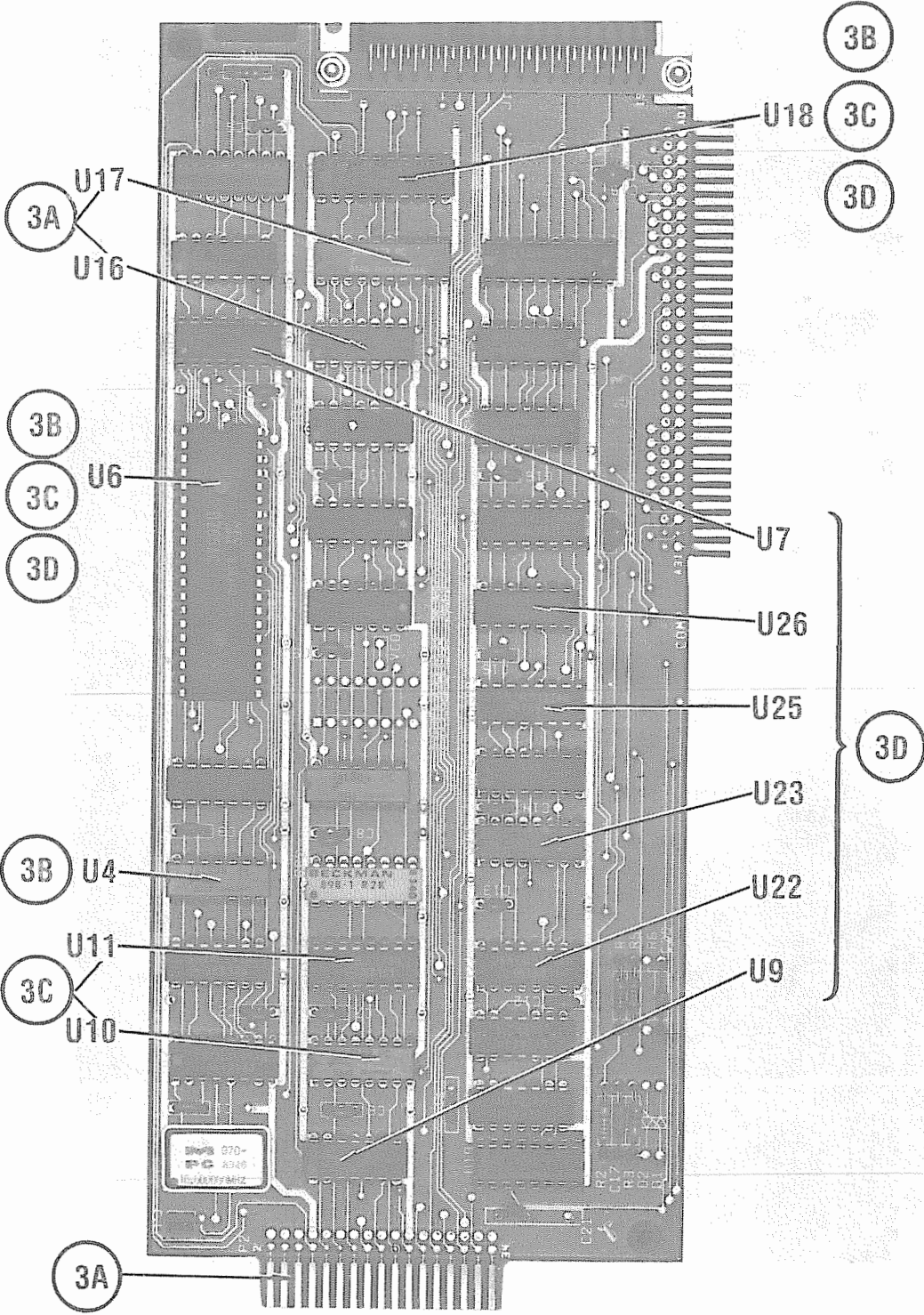
If a problem is detected various audio beeps may occur and/or an error code number may appear on the Monitor screen. Use the following charts to determine the area of the problem.

AUDIO	AREA OF PROBLEM
No beep or display.	Power Supply
Beeps continuously.	Power Supply
Repeated short beeps.	System Board
One long and one short beep	System Board
One long and two short beeps	Monochrome Monitor/Printer Adapter or Color Graphic Monitor Adapter
One short beep and improper or blank display	Monochrome Monitor/Printer Adapter or Color Graphic Monitor Adapter
One short beep and Basic statement on Monitor screen, with bootable diskette in Disk Drive and door closed.	Disk Drive Adapter

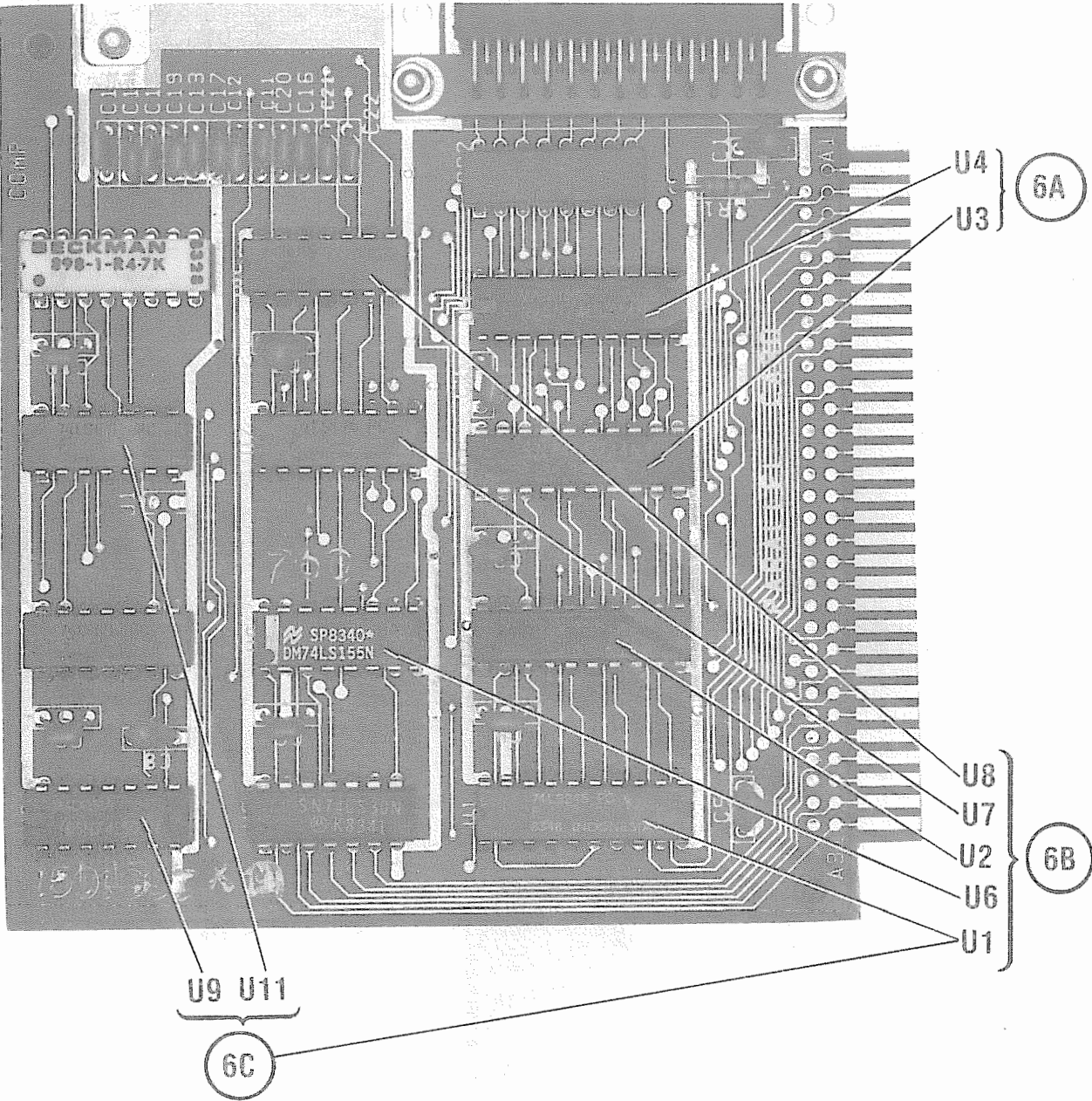
ERROR CODE	AREA OF PROBLEM
02X	Power Supply
1XX	System Board
20X or XX20X or XXXX	Memory
30X or XX30X	Keyboard
4XX	Monochrome Monitor/Printer Adapter
5XX	Color Graphic Monitor Adapter
6XX	Disk Drive
7XX	Math Coprocessor
9XX	Printer Adapter
11XX	Asynchronous Communication (RS232C)
12XX	Alternate Asynchronous Communication
13XX	Game Controller Adapter
14XX	Printer Adapter
15XX	Synchronous Data Link Control (SDLC) Communication Adapter
17XX	Hard (Fixed) Disk Drive
18XX	Expansion Unit
20XX	Binary Synchronous Communications (BSC) Adapter
21XX	Alternate BSC Adapter

X = Any number

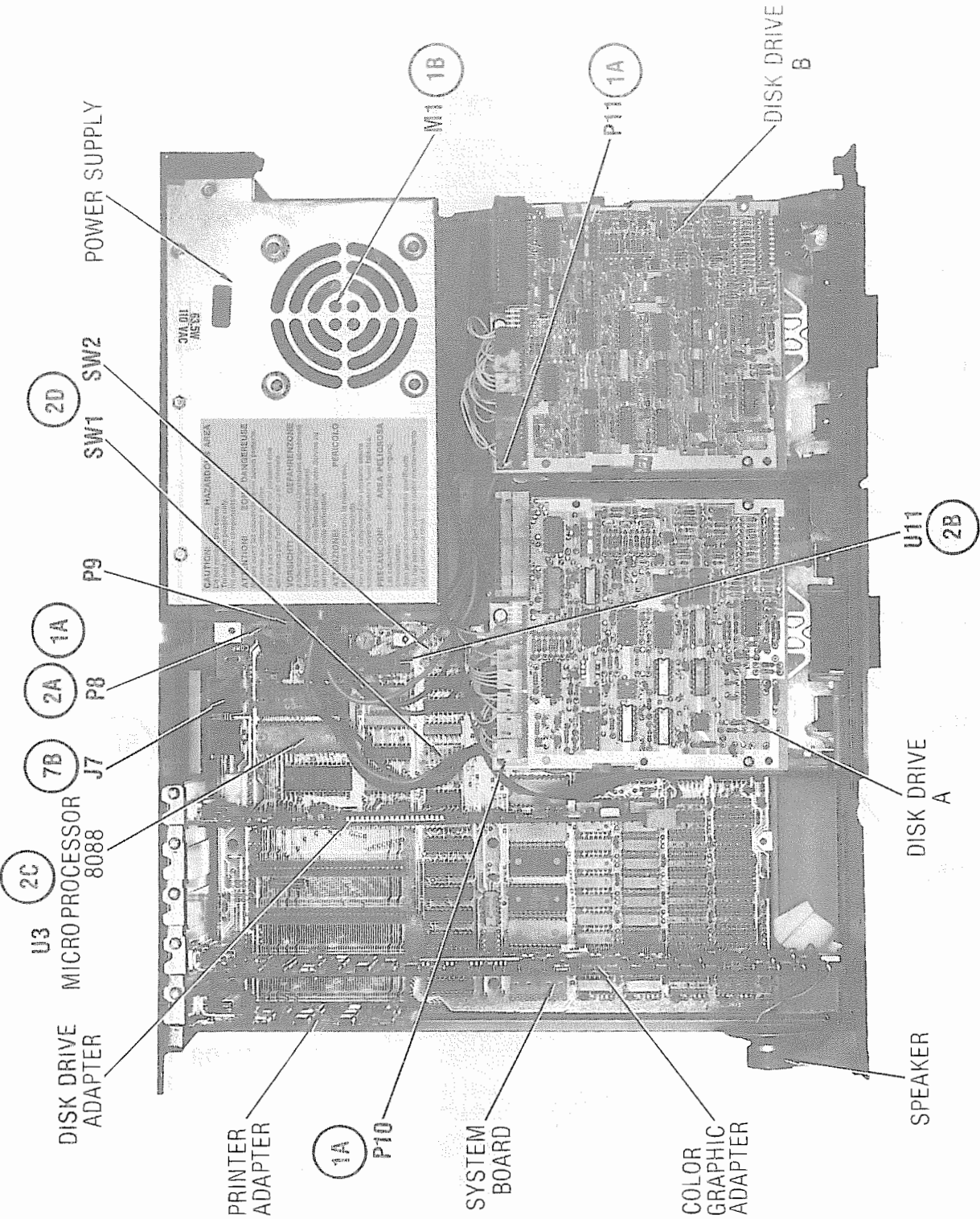
NOTE: The device tested good if the last two digits of the error code are zeros.



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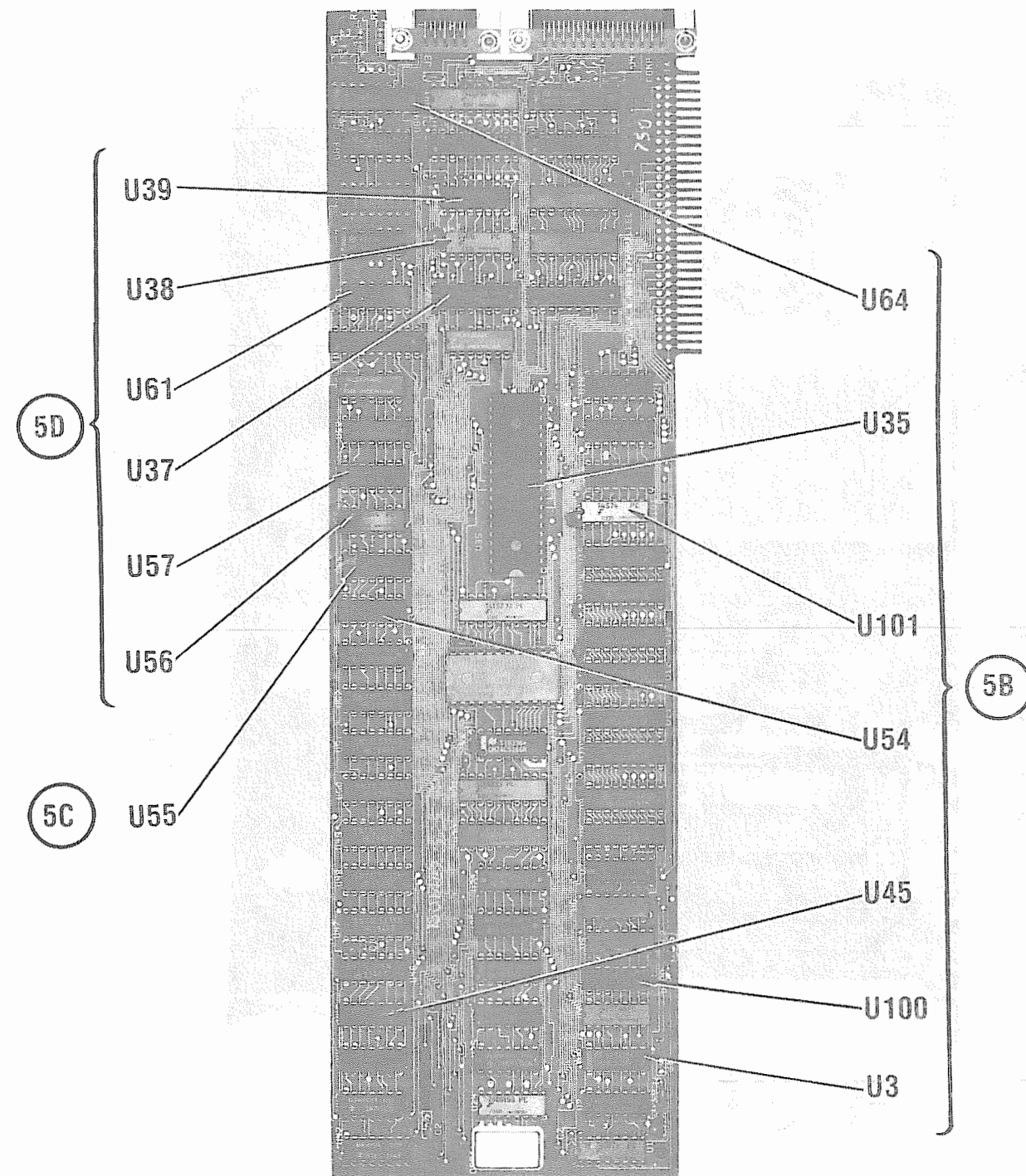


PRINTER ADAPTER
XII



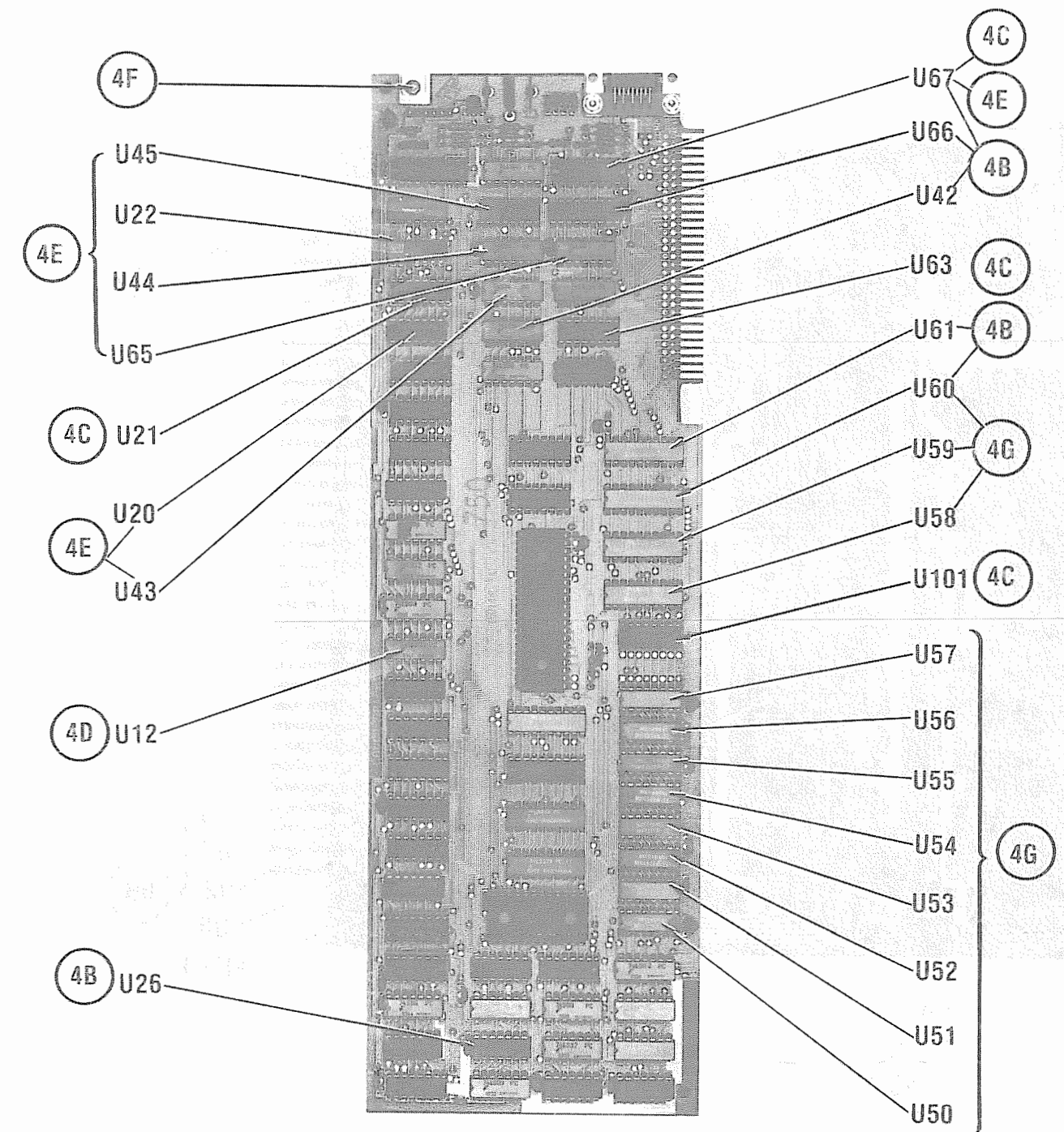
SYSTEM BOARD
V

PRELIMINARY SERVICE CHECKS (Continued)



MONOCHROME MONITOR/PRINTER ADAPTER

PRELIMINARY SERVICE CHECKS (Continued)



IBM
MODEL 5-150

COLOR GRAPHIC MONITOR ADAPTER

XI

PRELIMINARY SERVICE CHECKS (Continued)

SAFETY PRECAUTIONS

- 1. Use an isolation transformer for servicing.
- 2. Maintain AC line voltage at rated input.
- 3. Remove AC power from the computer system before servicing or installing electrostatically sensitive devices. Examples of typical ES devices are integrated circuits and semiconductor "chip" components.
- 4. Use extreme caution when handling the printed circuit boards. Some semiconductor devices can be damaged easily by static electricity. Drain off any electrostatic charge on your body by touching a known earth ground. Wear a commercially available discharging wrist strap device. This should be removed prior to applying power to the unit under test.
- 5. Use a grounded-tip, low voltage soldering iron.
- 6. Use an isolation (times 10) probe on scope.
- 7. Do not remove or install boards, floppy disk drives, printers, or other peripherals with computer system AC power On.
- 8. Do not use freon-propelled sprays. These can generate electrical charges sufficient to damage semiconductor devices.
- 9. This computer system is equipped with a grounded three-pronged AC plug. This plug must fit into a grounded AC power outlet. Do not defeat the AC plug safety feature.
- 10. Periodically examine the AC power cord for damaged or cracked insulation.
- 11. The computer system cabinet is equipped with vents to prevent heat build-up. Never block, cover, or obstruct these vents.
- 12. Instructions should be given, especially to children, that objects should not be dropped or pushed into the vents of the cabinet. This could cause shock or equipment damage.
- 13. Never expose the computer system to water. If exposed to water turn the unit off. Do not place the computer system near possible water sources.
- 14. Never leave the computer system unattended or plugged into the AC outlet for long periods of time. Remove AC plug from AC outlet during lightning storms.
- 15. Do not allow anything to rest on AC power cord.
- 16. Unplug AC power cord form outlet before cleaning computer system.
- 17. Never use liquids or aerosols directly on the computer system. Spray on cloth and then apply to the computer system cabinet. Make sure the computer system is disconnected from the AC power line.

PRELIMINARY SERVICE CHECKS (Continued)

SERVICE CHECKS

SEE INTERCONNECTING DIAGRAM, PLACEMENT CHART, AND PHOTOS TO MATCH THE NUMBER IN THE CIRCLES WITH THOSE IN THE FOLLOWING DATA FOR SERVICE CHECKS TO BE PERFORMED.

1. POWER SUPPLY

- (1) Power Supply shuts down. Disconnect Plugs P8, P9, P10 and P11. Turn Power Supply On and check for 5V at pin 1, 12V at pin 3, and - 12V at pin 4 of Plug P8. Check for - 5V at pin 3 and 5V at pins 4, 5, and 6 of Plug P9. Also check for 12V at pin 1 and 5V at pin 4 of Plugs P10 and P11. If any supply voltage is missing, check the Fuse (F1) inside the Power Supply. If open, replace fuse and turn Power Supply On. If fuse continues to blow, replace the Power Supply.
- (B) Power Supply shuts down after warm-up. Check that the Cooling Fan (M1) is running properly. If fan does not run correctly, replace fan. If problem recurs, replace Power supply.

2. SYSTEM BOARD

- (A) Computer does not turn On and there is no sound from the speaker. Check for 5V at pin 1 of Plug P8. A normal reading indicates that the Power Supply is operating properly.
- (B) Check for 5V at pin 18 of the Clock Generator IC (U11) and use a frequency counter to check for frequency of 14.31818MHz at pins 16 and 17 of IC U11. Also, check for the clock signal frequency of 4.77272MHz at pin 8 of IC U11. If the clock signal is missing, check IC U11 by substitution.
- (C) Check for 5V at pins 31 and 40 of the Microprocessor IC (U3). Use a frequency counter to check for the clock signal of 4.77272MHz at pin 19 of IC U3. If the clock signal is missing, check Clock Generator IC (U11) and IC U3 by substitution.
- (D) Check the settings of Switch Block 1 (SW1) and Switch Block 2 (SW2). These settings are determined by the hardware connected to the Computer and the size of memory used with the system.
- (E) If the Computer comes up and displays a parity failure message, check the code number that appears momentarily and locate which bank and which IC is causing the memory failure.

Except for the Basic Input Output System (BIOS) ROM IC (U33), the self-test (that is built into the computer) checks the RAM and ROMS automatically when the unit is turned On and momentarily displays an error code on the monitor screen if a defective IC is found.

When a RAM failure occurs, an alphanumeric code will be momentarily displayed at the top left corner of the monitor screen. This code will be four characters followed by 201. The number 201 indicates it is a memory failure. The first two characters indicate which bank has the bad IC. The third and fourth characters indicate which row in that bank is defective. The RAM bank that is soldered in is Bank 0. Use the following charts to find the defective IC.

	First Two Characters	
	16K/64K System Board	64K/256K System Board
Bank 0	00	00
Bank 1	04	10
Bank 2	08	20
Bank 3	0C	30

		Third and Fourth Characters							
		0	1	2	3	4	5	6	7
Row	Parity	01	02	04	08	10	20	40	80

Example: 1020 201 would be bank 1 row 5, IC (U59) on the 64K/256K system board.

If the third and fourth characters do not match those given in the chart, substitute the entire nine ICs of that bank and recheck the memory. If an error code still appears, troubleshoot the RAM address decode and chip select circuits.

When a ROM failure occurs on the 64K/256K System Board a four character alphanumeric code will appear on the monitor screen. Use the following chart to determine which IC is indicated and check the IC by substitution.

ROM CODE CHART

CODE	DEVICE
F600	U29
F800	U30
FA00	U31
FC00	U32

ROM IC U33 is not checked since it contains the test program. If IC U33 does not appear to be functioning, check it by substitution. If IC U33 still does not function, check for pulses at pin 20 of IC U33. If the pulses are missing, check the logic probe readings on pins 1 thru 6 of Decoder IC (U46). If the readings are normal, check IC U46 by substitution.

CSCS2

IBM
MODEL 5150

PRELIMINARY SERVICE CHECKS (Continued)

SERVICE CHECKS (Continued)

3. DISK DRIVE ADAPTER

Be certain that each Disk Drive is good before troubleshooting the Disk Drive Adapter. If Drive A does not boot, unplug the data cable from Drive A and plug it into Drive B. Reset the Computer and boot using Disk Drive B. If Drive B operates normally, the problem is in Drive A. If Drive B does not boot, check the power supply sources at the power supply plug. If the sources are normal, troubleshoot the Disk Drive Adapter.

- (A) When the indicator lights of both Disk Drives A and B turn on at the same time, make sure the data cable is correctly plugged into the Adapter edge connectors and check ICs U16 and U17 by substitution.
- (B) When a Seek Error message appears on the Monitor screen, it indicates a track is unreadable or a head alignment malfunction has occurred on one or both Disk Drives. Check ICs U4, U6 and U18 by substitution.
- (C) When a Disk Drive damages data on a write protected diskette, check ICs U6, U11, U10 and U18 by substitution.
- (D) If unable to read data on either Disk Drive, check ICs U6, U7, U9, U18, U22, U23, U25 and U26 by substitution.

3.1 DISK DRIVE

- (A) When information is not received into memory even though the Disk Drive indicator light is lit, check to see that the drive motor is running. Also, check the speed and adjust Speed Adjust Control (R4A) if the speed is not correct. If the drive belt is loose, change the belt.
- (B) Disk Drive does not read or boot a DOS diskette. Use an Alignment Diskette and check the 0 Track Adjustment. Unplug the data cable from Drive A and plug it into Drive B. Boot the DOS diskette using Drive B and if Drive operates normally, troubleshoot or replace Disk Drive A.
- (C) Disk Drive is intermittent. Use a Head Cleaning Diskette to clean the heads. Also, check the speed and the alignment of the drive mechanism.
- (D) If the Disk Drive writes or erases information on a diskette even when the diskette is write protected, change the Disk Drive board of that Drive. NOTE: Use only back-up copies of original diskettes in a Drive with this problem, because the information on the diskette may be lost.

4. COLOR GRAPHICS MONITOR ADAPTER

- (A) If there is no Cursor on the screen, check the setting of switches 5 and 6 of Switch Block 1 (SW1) on the System Board. Set switches according to the type of Monitor (Color or Monochrome) and number of Monitors connected to the Computer.
- (B) System shuts down when the Color Graphic Monitor Adapter is installed. Check ICs U26, U42, U60, U61, U66 and U67 by substitution.
- (C) No horizontal or vertical sync. Check ICs U21, U63, U67 and U101 by substitution.
- (D) If the Cursor is missing or not blinking, check IC U12 by substitution.
- (E) For fading color or wrong color, check ICs U20, U22, U43, U44, U45, U65 and U67 by substitution.
- (F) Some units are using earlier production of Color Graphic Monitor Adapters which require connecting the bracket directly to the chassis ground.
- (G) For RAM Data Out, check ICs U50 thru U60 by substitution.

5. MONOCHROME MONITOR/PRINTER ADAPTER

- (A) If there is no Cursor on the screen, check the setting of switches 5 and 6 of Switch Block 1 (SW1) on the System Board. Set switches according to the type of Monitor (Color or Monochrome) and number of Monitors connected to the Computer.
- (B) System shuts down when Monochrome Monitor/Printer Adapter is installed. Check ICs U3, U35, U45, U54, U64, U100 and U101 by substitution.
- (C) If the Cursor is missing or not blinking, check IC U55 by substitution.
- (D) Printer does not print any information. Check ICs U37, U38, U39, U56, U57 and U61 by substitution.

6. PRINTER ADAPTER

- (A) Printer types random characters (garbage). Check ICs U3 and U4 by substitution.
- (B) Printer does not print. Check ICs U1, U2, U6, U7 and U8 by substitution.
- (C) System shuts down when Printer Adapter is installed. Check ICs U1, U9 and U11 by substitution.

PRELIMINARY SERVICE CHECKS (Continued)

SERVICE CHECKS (Continued)

7. KEYBOARD

- (A) Keyboard does not function. Disconnect it from Computer and check the cable for continuity. If the cable is open, replace it. If cable is good, see step (B).
- (B) Connect the Keyboard to the System Board. Check for 5V at pins 26 and 40 of Microcomputer IC (M1) on the Keyboard. If the readings check less than 3V, replace the Keyboard.
- (C) If one of the keys does not function, replace the Keyboard.
- (D) If many characters are printed when only one key is pressed, replace the Keyboard.

TEST EQUIPMENT AND TOOLS

TEST EQUIPMENT

Digital Volt/Ohm Meter

Frequency Counter

TOOLS

Soldering Iron

Desoldering Equipment

Alignment Diskette

Head Cleaning Diskette and Equipment

REPLACEMENT PARTS

F1	Fuse (2A @250V Slow-Blow)
M1	Fan, Cooling
SW1	Switch Block 1
SW2	Switch Block 2, RAM Select Belt, Disk Drive (Part No. 8529154)

Part Numbers obtained from the IBM Hardware Maintenance and Service Manual (Part Number 6025072)
Courtesy of IBM

IC TYPE NO.

SYSTEM BOARD

U3	P8088
U11	UPB8284AD

KEYBOARD

M1	8340X7
----	--------

MONOCHROME MONITOR /PRINTER ADAPTER

U1	74LS74APC
U2	SN74LS04N
U3	DM74LS08N
U4	74LS74APC
U6	74LS10PC
U7	SN74LS139AN

U8	MCM2114P20 2114L
U9	MCM2114P20 2114L
U11	MCM2114P20 2114L
U35	MC6845P MC6845
U37	SN74LS 240N
U38	7405PC
U39	DM74LS174N
U45	74LS74APC
U54	DM74S86N
U55	DM74LS174N
U56	74LS04PC
U57	DM74LS02N
U61	74LS155PC
U64	DM74LS244N
U100	74LS32N
U101	74LS74PC

COLOR GRAPHIC MONITOR ADAPTER

U12	74LS393PC
U20	SN74LS04N
U21	DM74LS174N
U22	74LS51PC
U26	DM74S04N
U42	74LS86PC
U43	74S74PC
U44	74S74PC
U45	DM74LS151N
U50	MK4516N-12 thru 2118-4
U57	
U58	74LS374PC thru U61
U63	DM74LS175N
U65	74LS02PC
U66	SN74LS245N
U67	SN74LS244N
U101	SN74S174N

DISK DRIVE ADAPTER /DISK DRIVE (A & B) TYPE 1

U4	74LS08PC
U6	D765AC UPD765
U7	MC3487P MC3487
U9	DM7438N
U10	74LS153PC
U11	SN74LS175N
U16	DM7438N 7438-4
U17	74LS273PC
U18	DM74LS240N
U22	SN74LS112AN
U23	74LS161APC
U25	SN74LS112AN
U26	SN74LS02N

CSCS2-A
IBM
MODEL 5150

CSGS2-A IBM MODEL 5150

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Logic Charts	7,8,9	IC Pinouts and Terminal Guides	5,12
Parts List	9,10	Monochrome Monitor/ Printer Adapter	2,3,4, 13, 15, 16, 17
		Notes	14

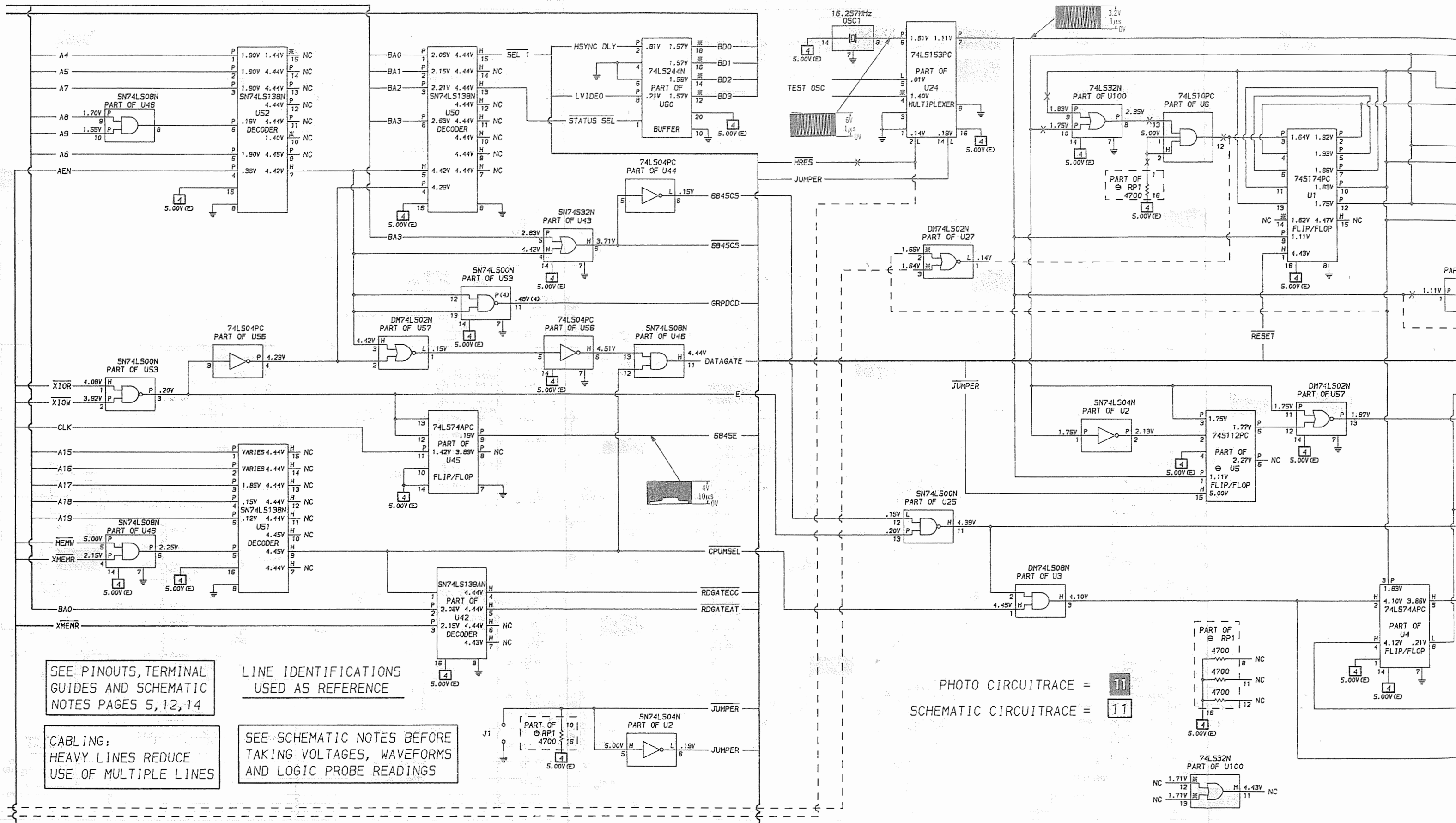
The listing of any available replacement part herein does not constitute in any case a recommendation, warranty or guaranty by Howard W. Sams & Co., Inc., as to the quality and suitability of such replacement part. The numbers of these parts have been compiled from information furnished to Howard W. Sams & Co., Inc., by the manufacturers of the particular type of replacement part listed.

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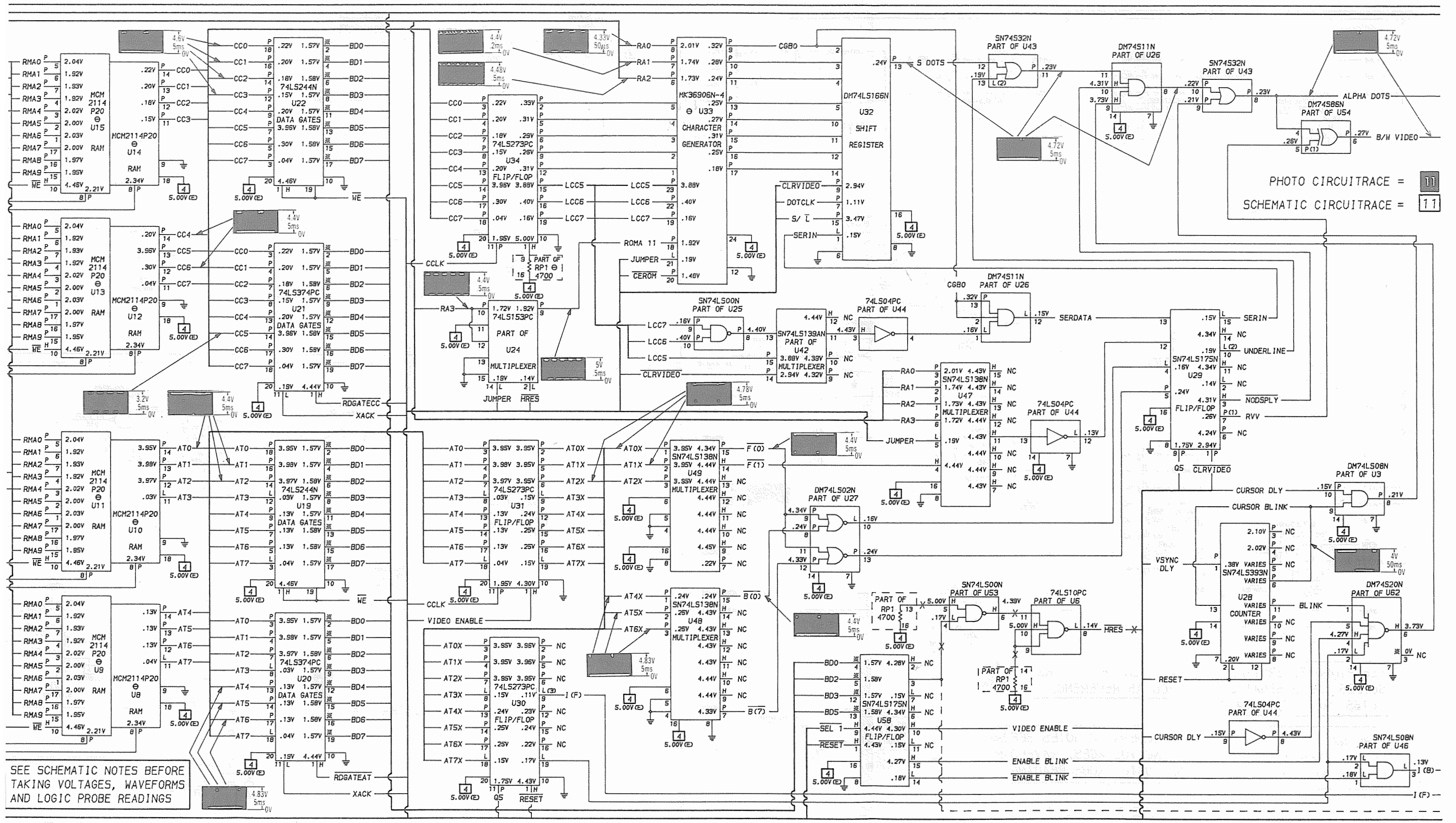


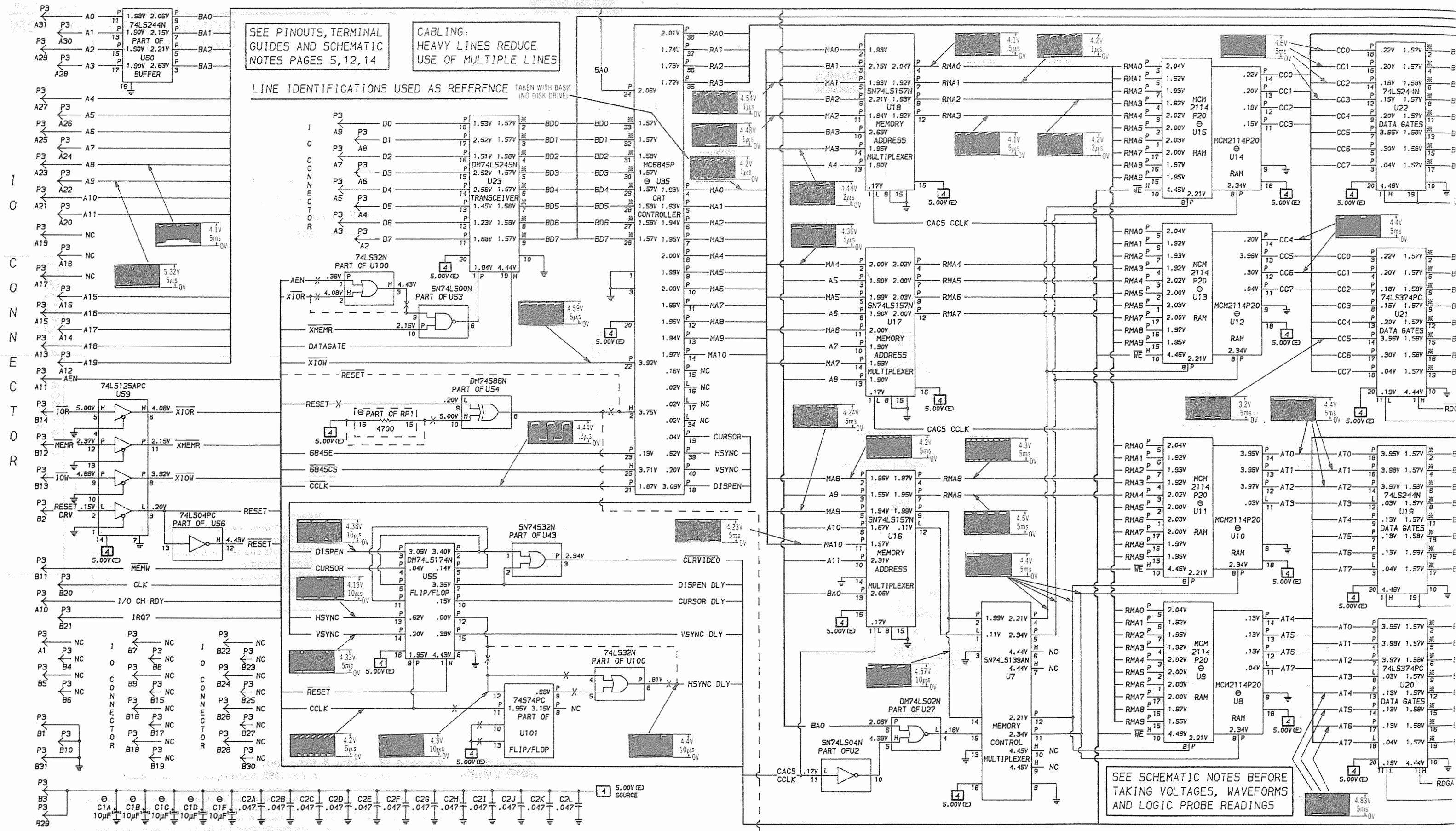
A PHOTOFAC STANDARD NOTATION SCHEMATIC

WITH **CIRCUITRACE**

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MONOCHROME MONITOR/PRINTER ADAPTER





A0 Thru A11	Address Lines
A15 Thru A19	Address Lines
ACK	Acknowledge
AEN	Address Enable
ALPHA DOTS	Alpha Dots
AT0 Thru AT7	Attributes Lines
AT0X Thru AT7X	Attributes Buffer Lines
AUTO FD XT	Auto Feed External
B(0), B(7)	
B/W VIDEO	Black/White Video
BA0 Thru BA3	Buffer Address Lines
BD0 Thru BD7	Buffer Data Lines
BLINK	Blink
BUSY	Busy
CACS CCLK	Control Address Chip Select Control Clock
CC0 Thru CC7	Character Code Lines
CCLK	Control Clock
CEROM	Chip Enable ROM
CGB0	
CLK	Clock
CLRVIDEO	Clear Video
CPUMSEL	CPU Memory Select
CURSOR	Cursor
CURSOR DLY	Cursor Delay
CURSOR BLINK	Cursor Blink
D0 Thru D7	Data Lines
DATA0 THRU DATA7	Data Lines
DATAGATE	Data Gate
DISPEN	Display Enable
DISPEN DLY	Display Enable Delay
DOTCLK	Dot Clock
E	
ENABLE BLINK	Enable Blink
ERROR	Error
F(0), F(1)	
GRPDCD	
HIGH LIGHT	High Light
HORIZ DRIVE	Horizontal Drive
HRES	High Resolution
HSYNC	Horizontal Sync
HSYNC DLY	Horizontal Sync Delay
I(B), I(F)	
I/O CH RDY	I/O Channel Ready
INIT	Initialize

IOR	Input/Output Read
IOW	Input/Output Write
IRQ7	Interrupt Request
IRGEN	Interrupt Request Enable
JUMPER	Jumper
LCC5 Thru LCC7	
LVIDEO	
MA0 Thru MA10	Memory Address Lines
MEMR	Memory Read
MEMW	Memory Write
NODSPLY	
PE	Paper End
Q5	
RA0 Thru RA3	Row Address Lines
RDGATEAT	Read Gate Attribute
RDGATECC	Read Gate Character Code
RESET	Reset
RESET DRV	Reset Drive
RMA0 Thru RMA9	Read Memory Address Lines
ROMA 11	
RPA Thru RPC	
RVV	Reverse Video
S DOTS	Serial Dots
S/L	
SEL 1	
SERDATA	
SERIN	
SLECT	Select
SLECTIN	Select Input
STATUS SEL	Status Select
STROBE	Strobe
UNDERLINE	Underline
VERT DRIVE	Vertical Drive
VIDEO	Video
VIDEO ENABLE	Video Enable
VSNC	Vertical Sync
VSNC DLY	Vertical Sync Delay
WE	Write Enable
WPA	Write Printer Data
WPC	Write Printer Control
XACK	Buffered Acknowledge
XIOR	Buffered I/O Read
XIOW	Buffered I/O Write
XMEMR	Buffered Memory Read

Any Bar above any alphabetical or numerical combination indicates line active in a low (0) state.

SCHEMATIC NOTES

— Circuitry not used in some versions

--- Circuitry used in some versions

• See parts list

⊕ Ground

⏏ Chassis

▽ Common tie point

Waveforms and voltages taken from ground, unless noted otherwise.

Voltages, Waveforms and Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Waveforms taken with triggered scope and Sweep/Time switch in Calibrate position, scope input set for DC coupling on 0 reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 7 cm. width with DC reference voltage given at the bottom line of each waveform.

Time in μ sec. per cm, given with p-p reading at the end of each waveform.

Item numbers in rectangles appear in the alignment/adjustment instructions.

Supply voltages maintained as shown at input.

Voltages measured with digital meter, no signal.

Controls adjusted for normal operation.

Terminal identification may not be found on unit.

Capacitors are 50 volts or less, 5% unless noted.

Electrolytic capacitors are 50 volts or less, 20% unless noted.

Resistors are $\frac{1}{2}$ W or less, 5% unless noted.

Value in () used in some versions.

Measurements with switching as shown, unless noted.

Logic Probe Display

L = Low

H = High

P = Pulse

* = Open (No light On)

(1) Probe indicates L when reverse video feature is not used.

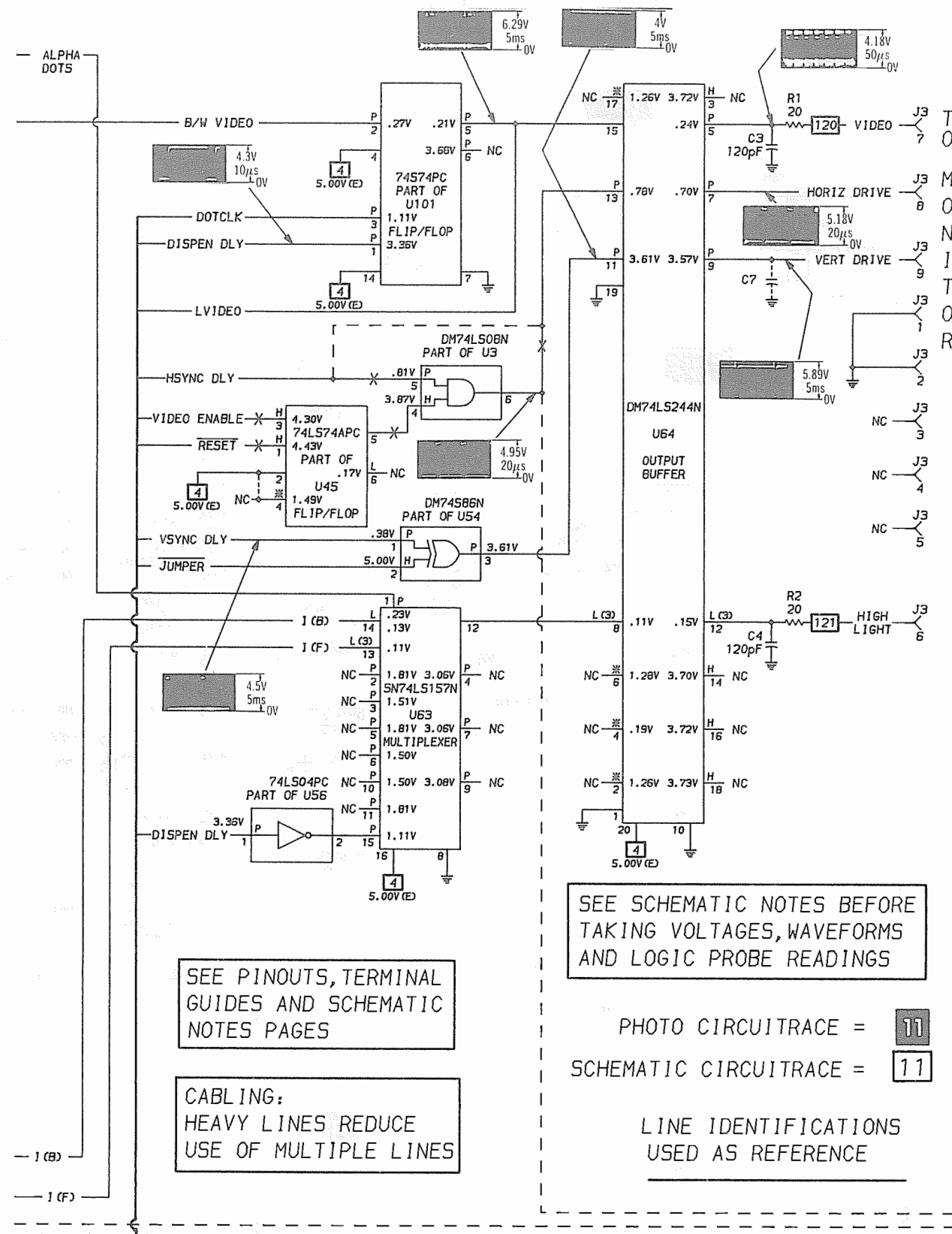
(2) Probe indicates P when underline feature is used.

(3) Probe indicates P when highlight (intensity) feature is used.

(4) Logic probe reading taken while running the following program.

10 PRINT "PERSONAL"

20 GOTO 10



A PHOTOFACT STANDARD NOTATION SCHEMATIC

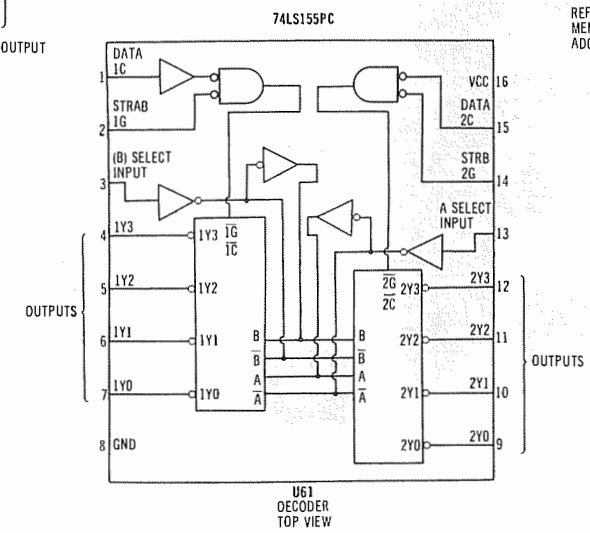
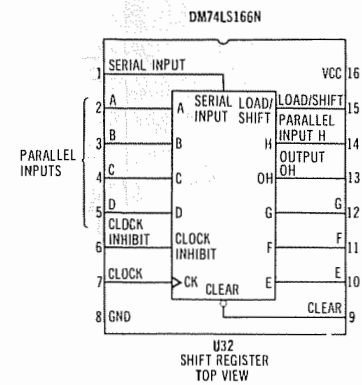
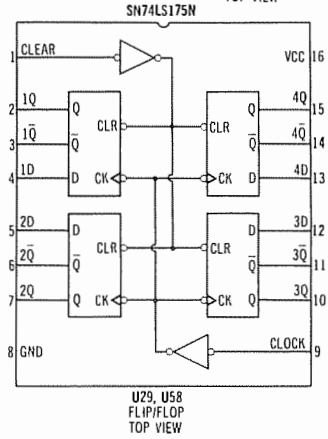
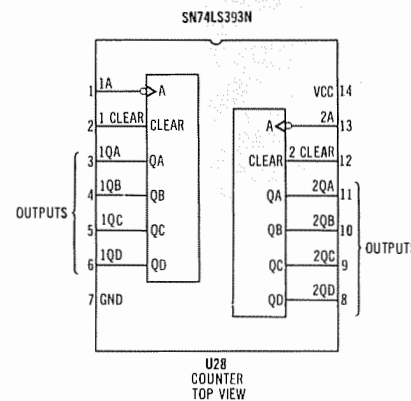
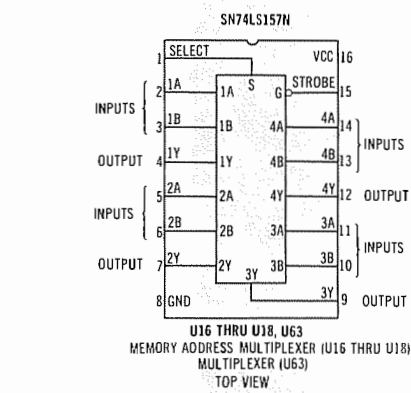
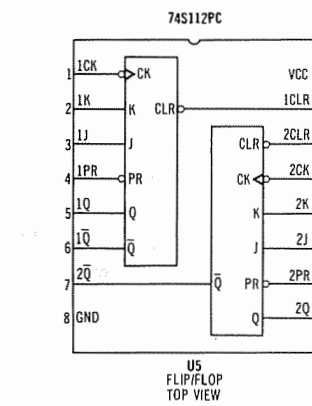
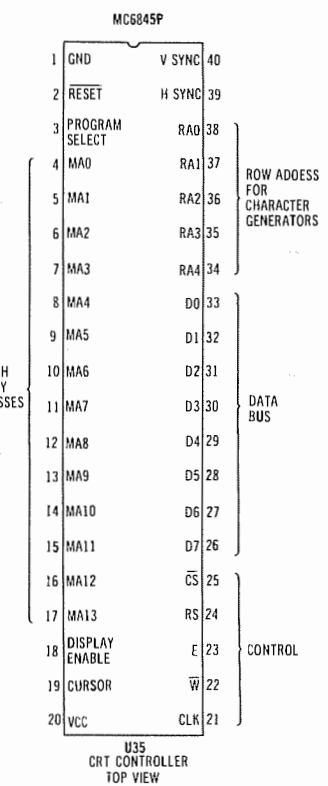
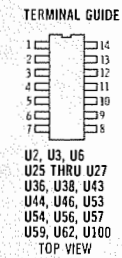
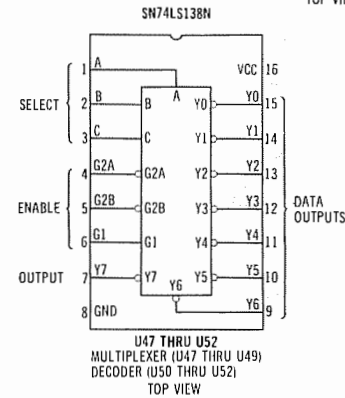
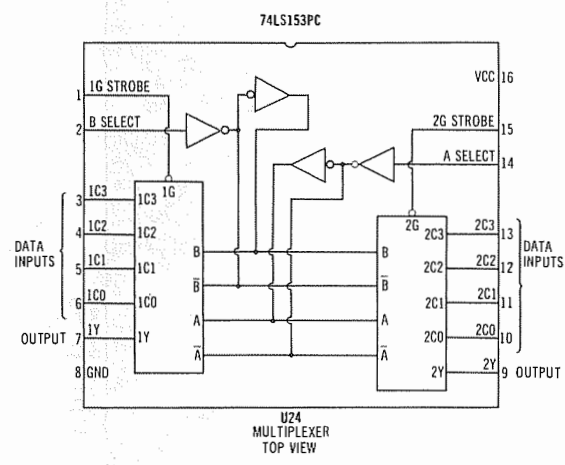
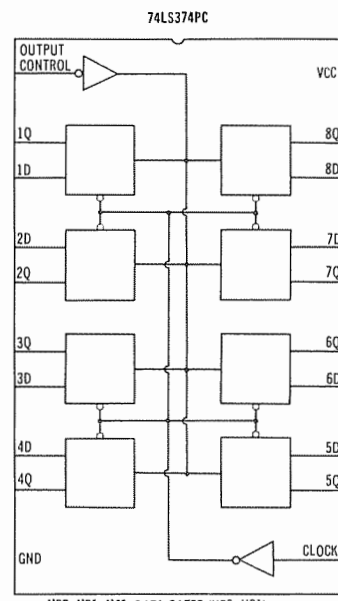
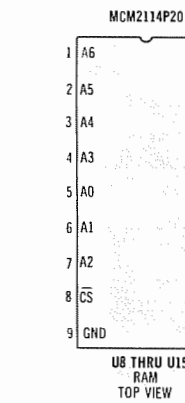
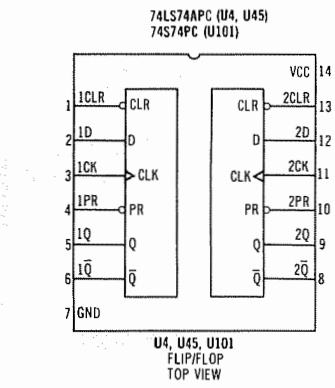
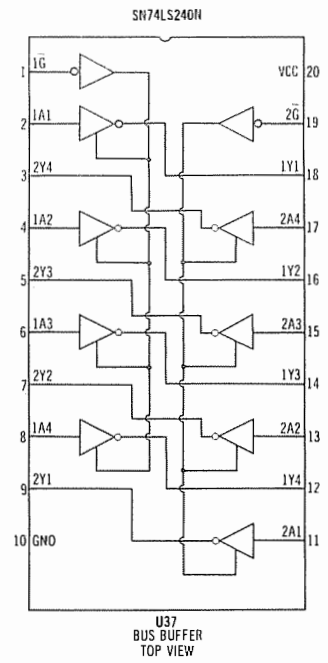
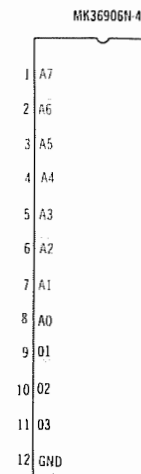
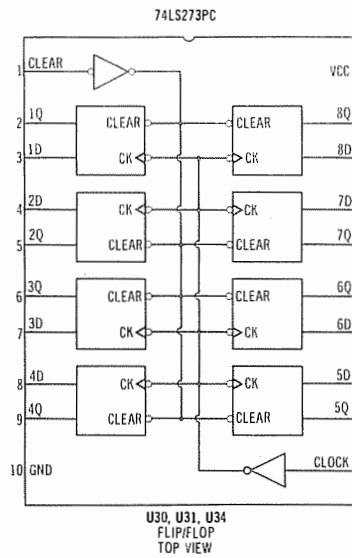
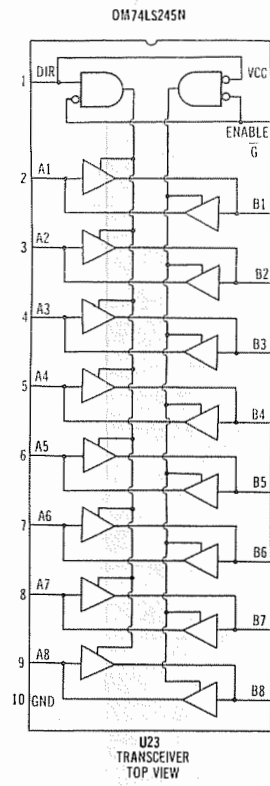
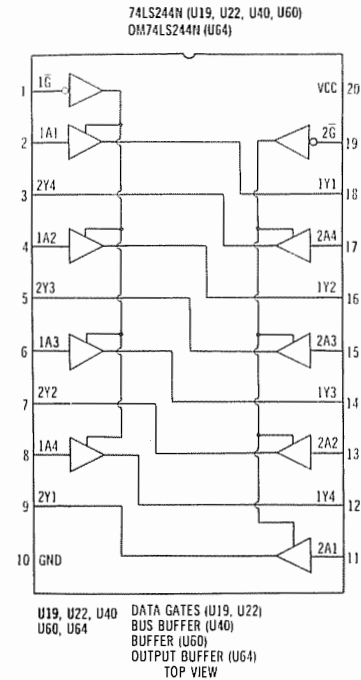
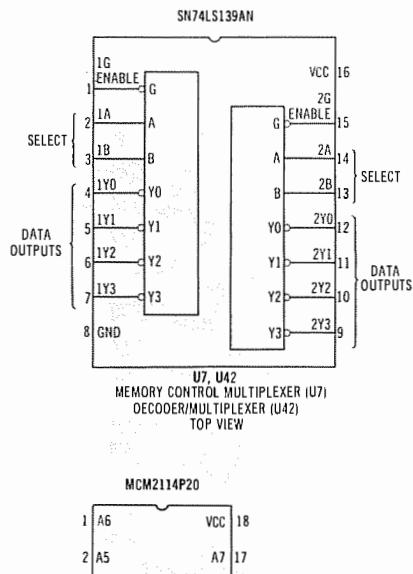
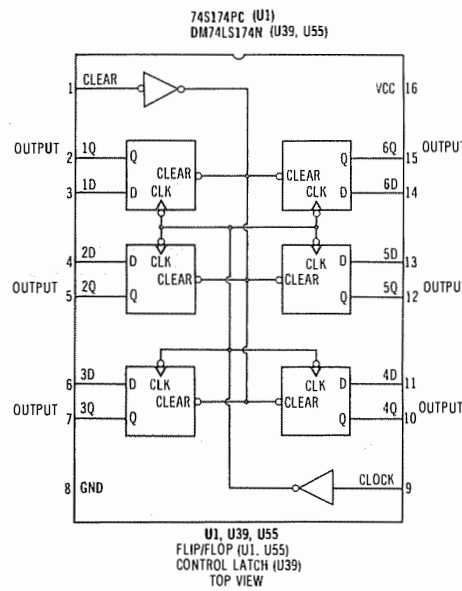
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MONOCHROME MONITOR/PRINTER ADAPTER

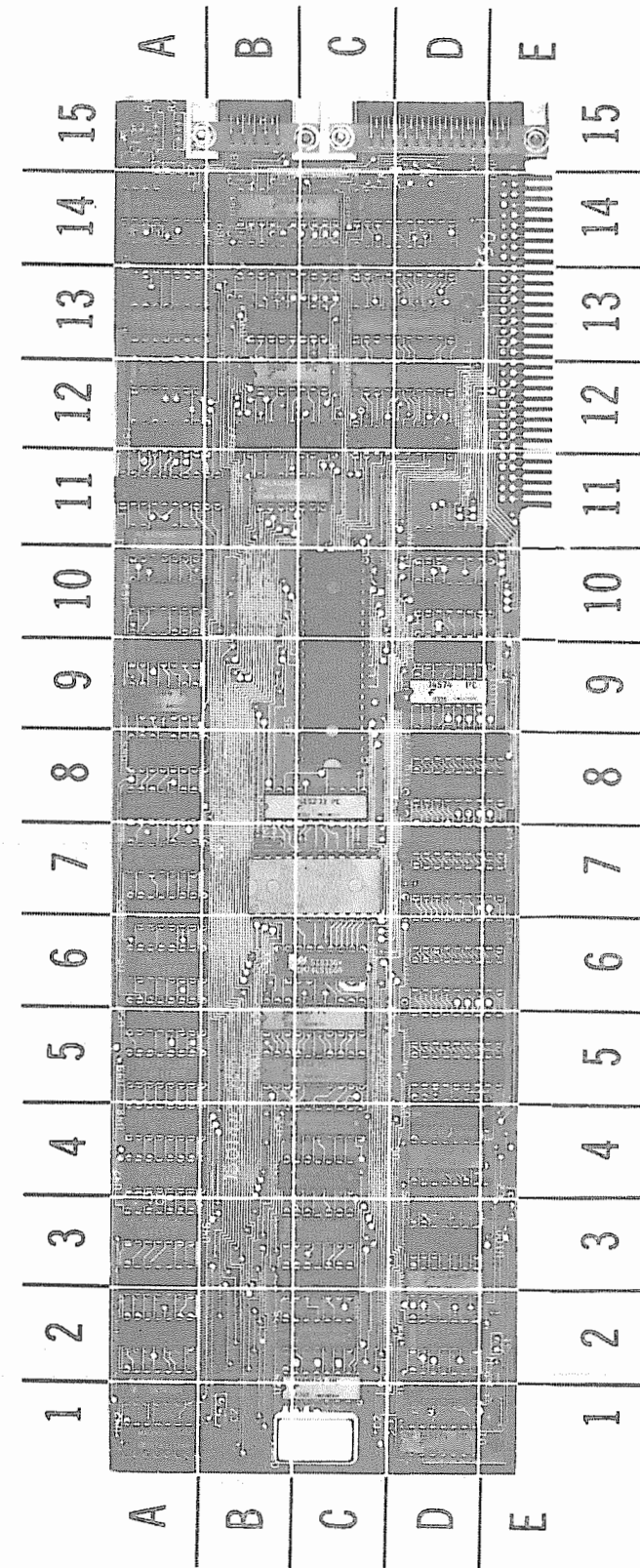
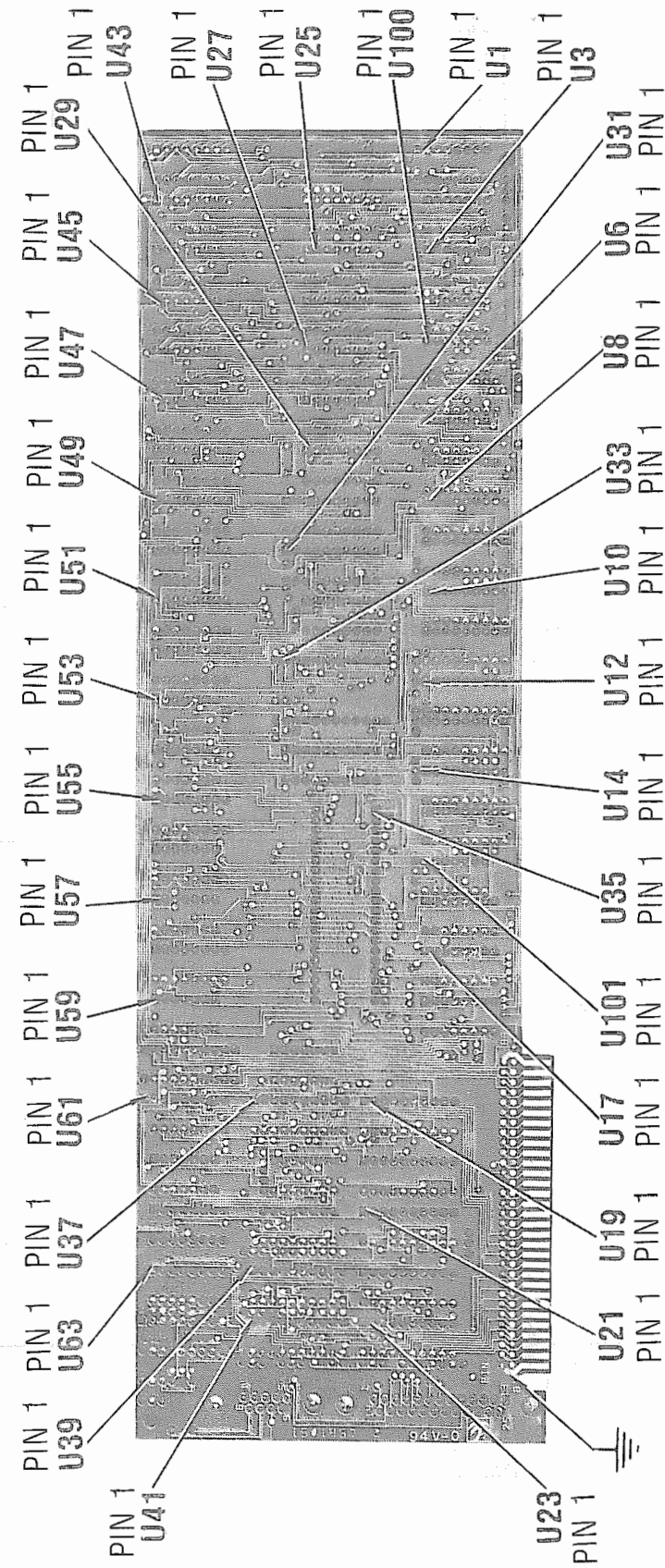
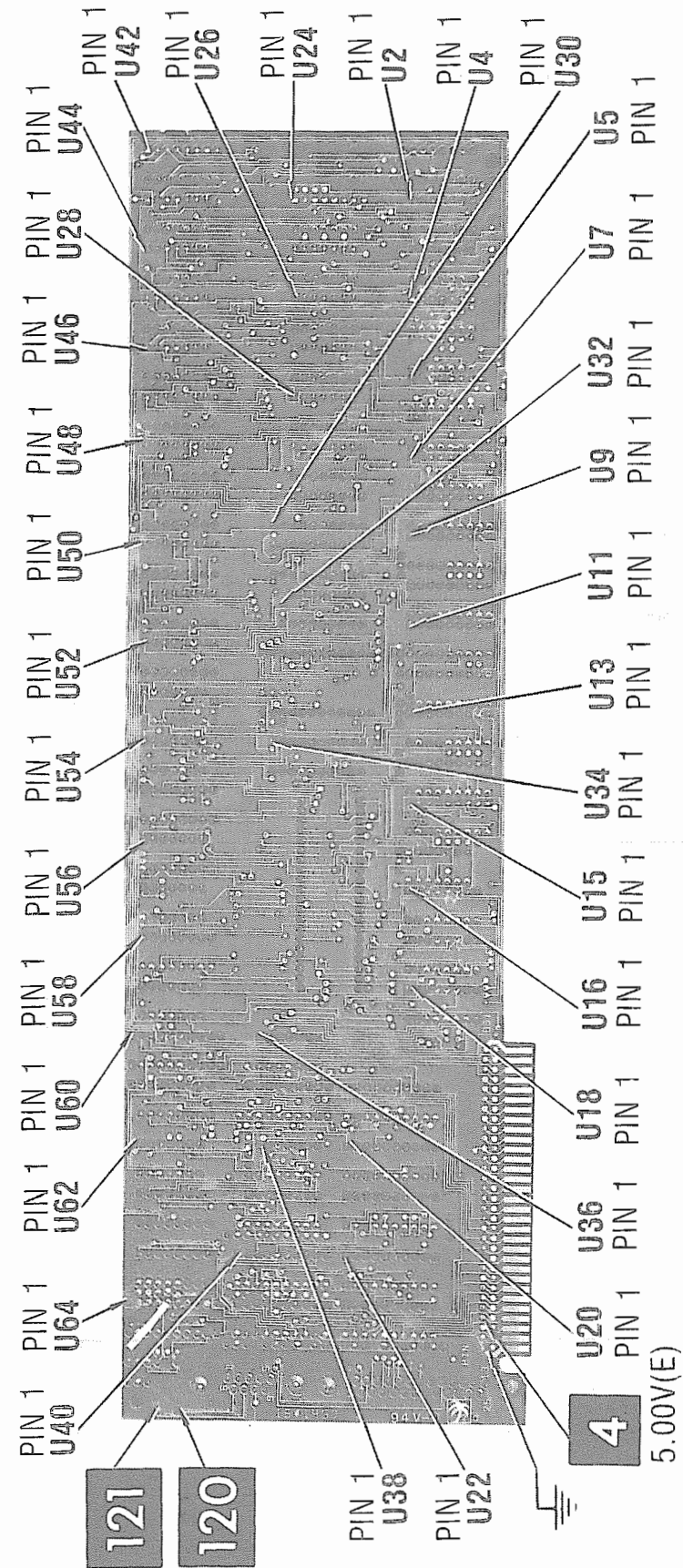
CS2-A
MODEL 5150

IC PINOUTS & TERMINAL GUIDES



MONOCHROME MONITOR/PRINTER ADAPTER

MONOCHROME MONITOR/PRINTER ADAPTER



MONOCHROME MONITOR/PRINTER ADAPTER GridTrace LOCATION GUIDE

MONOCHROME MONITOR/PRINTER ATTACHER LOCATION GUIDE													
C1A	A-3	C2L	D-9	J4	C-15	U11	D-6	U26	B-2	U41	B-14	U56	A-9
C1B	B-12	C2M	C-10	M1	C-1	U12	D-7	U27	B-3	U42	A-1	U57	A-9
C1C	D-7	C3	A-15	R1	A-15	U13	D-7	U28	B-4	U43	A-1	U58	A-10
C1D	E-1	C4	A-15	R2	A-15	U14	D-8	U29	B-4	U44	A-2	U59	A-10
C1E	D-13	C5A	B-14	RP1	A-13	U15	D-8	U30	B-5	U45	A-2	U60	A-11
C2A	B-1	C5B	B-14	U1	D-1	U16	D-9	U31	B-5	U46	A-3	U61	A-11
C2B	B-6	C5C	C-14	U2	D-1	U17	D-10	U32	B-6	U47	A-4	U62	A-12
C2C	B-7	C5D	D-14	U3	D-2	U18	D-10	U33	B-6	U48	A-4	U63	A-13
C2D	B-7	C5E	D-14	U4	D-2	U19	C-11	U34	B-8	U49	A-5	U64	A-14
C2E	A-14	C5F	C-14	U5	D-3	U20	C-12	U35	C-8	U50	A-5	U100	D-3
C2F	C-1	C5G	B-14	U6	D-4	U21	C-13	U36	B-11	U51	A-6	U101	D-9
C2G	E-3	C5H	B-14	U7	D-4	U22	C-13	U37	B-12	U52	A-6		
C2H	D-5	C5J	B-13	U8	D-5	U23	C-14	U38	B-12	U53	A-7		
C2J	D-7	C6	E-2	U9	D-5	U24	B-1	U39	B-13	U54	A-8		
C2K	D-8	J3	B-15	U10	D-6	U25	B-2	U40	B-13	U55	A-8		

MODEL 5150

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS

ITEM No.	TYPE No.	MFGR. PART No.	ITEM No.	TYPE No.	MFGR. PART No.
MONOCHROME MONITOR/PRINTER ADAPTER			U34	74LS273PC	
U1	74S174PC		U35	MC6845P	
U2	SN74LS04N			MC6845	
U3	DM74LS08N		U36	74LS125APC	
U4	74LS74APC		U37	SN74LS240N	
U5	74S112PC		U38	7405PC	
	74S112A		U39	DM74LS174N	
U6	74LS10PC		U40	74LS244N	
U7	SN74LS139AN		U41	74LS374PC	
U8	MCM2114P20		U42	SN74LS139AN	
thru	2114L				
U15			U43	SN74S32N	
			U44	74LS04PC	
U16	SN74LS157N		U45	74LS74APC	
thru			U46	SN74LS08N	
U18			U47	SN74LS138N	
U19	74LS144N		thru		
U20,21	74LS374PC		U52		
U22	74LS244N				
			U53	SN74LS00N	
U23	DM74LS245N		U54	DM74S86N	
U24	74LS153PC		U55	DM74LS174N	
U25	SN74LS00N		U56	74LS04PC	
U26	DM74S11N		U57	DM74LS02N	
U27	DM74LS02N				
			U58	SN74LS175N	
U28	SN74LS393N		U59	74LS125APC	
U29	SN74LS175N		U60	74LS244N	
U30,31	74LS273PC		U61	74LS155PC	
U32	DM74LS166N		U62	DM74S20N	
U33	MK36906N-4				
	MK36000		U63	SN74LS157N	
			U64	DM74LS244N	
			U100	74LS32N	
			U101	74S74PC	

ELECTROLYTIC CAPACITORS

Items not listed are normally available at local distributors.

ITEM No.	RATING	MFGR. PART No.	ITEM No.	RATING	MFGR. PART No.
MONOCHROME MONITOR/PRINTER ADAPTER			C1C	10 16V 10% (1)	
C1A	10 16V 10% (1)		C1D	10 16V 10% (1)	
C1B	10 16V 10% (1)		C1F	10 16V 10% (1)	

(1) 8.2 used in some versions.

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA	
		MFGR. PART No.	NOTES
MONOCHROME MONITOR/ PRINTER ADAPTER RP1	Resistor Network (1)	316A472 Q5547008 (2)	

(1) Contains fifteen 4700.
(2) Number on unit.

MONOCHROME MONITOR/PRINTER ADAPTER LOGIC

PIN NO.	IC U1	IC U2	IC U3	IC U4	IC U5	IC U6	IC U7	IC U8	IC U9	IC U10	IC U11	IC U12	IC U13	IC U14	IC U15
1	H	P	H	H	P	H	L	P	P	P	P	P	P	P	P
2	P	P	H	H	P	H	P	P	P	P	P	P	P	P	P
3	P	P	H	P	P	P	L	P	P	P	P	P	P	P	P
4	P	P	H	H	H	P	P	P	P	P	P	P	P	P	P
5	P	H	P	H	P	L	P	P	P	P	P	P	P	P	P
6	P	L	P	L	P	H	H	P	P	P	P	P	P	P	P
7	P	L	L	L	P	L	H	P	P	P	P	P	P	P	P
8	L	P	P	L	L	L	L	P	P	P	P	P	P	P	P
9	P	P	P	H	P	H	H	L	L	L	L	L	L	L	L
10	P	H	P	L	H	H	H	H	H	H	H	H	H	H	H
11	P	L	P	P	P	H	P	L	L	L	L	L	L	L	L
12	P	L	P	H	P	P	P	P	P	P	P	P	P	P	P
13	P	H	P	H	P	P	L	P	P	P	P	P	P	P	P
14	*	H	H	H	H	H	P	P	P	P	P	P	P	P	P
15	H				H		L	P	P	P	P	P	P	P	P
16	H				H		H	P	P	P	P	P	P	P	P
17								P	P	P	P	P	P	P	P
18								H	H	H	H	H	H	H	H
PIN NO.	IC U16	IC U17	IC U18	IC U19	IC U20	IC U21	IC U22	IC U23	IC U24	IC U25	IC U26	IC U27	IC U28	IC U29	IC U30
1	L	L	L	H	H	H	H	P	L	P	L	L	P	P	H
2	P	P	P	*	*	*	*	*	L	P	P	*	L	L	P
3	P	P	P	L	P	P	P	*	L	P	H	*	L	L	P
4	P	P	P	*	P	P	*	*	*	P	L	L	P	L	P
5	P	P	P	P	*	*	P	*	L	P	P	H	P	P	P
6	P	P	P	*	*	*	*	*	P	P	L	P	P	P	P
7	P	P	P	*	P	P	*	*	L	L	L	L	L	L	L
8	L	L	L	*	L	P	*	*	L	L	L	L	L	L	L
9	P	P	P	P	*	*	P	*	P	P	H	P	P	P	L(3)
10	P	P	P	L	L	L	L	L	P	P	H	L	L	L	L
11	P	P	P	*	L	L	*	P	H	H	L	L	L	L	L
12	L	P	P	L	*	*	P	P	P	L	L	L	L	L	L
13	P	P	P	*	P	P	*	P	L	P	P	P	P	L	P
14	L	P	P	*	P	P	*	P	L	H	H	H	H	L	P
15	L	L	L	*	*	*	*	P	L					L	P
16	H	H	H	P	*	*	P	P	H					L	P
17					P	P	*	P						L	P
18					L	P	P	P						L	P
19					*	*	H	H						L	P
20				H	H	H	H	H						L	P

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No light On)

- (1) Probe indicates L when reverse video feature is not used.
(2) Probe indicates P when underline feature is used.
(3) Probe indicates P when highlight (intensity) feature is used.

CSCS2-A
MODEL 5150
IBM

MONOCHROME MONITOR/PRINTER ADAPTER LOGIC (Continued)

PIN NO.	IC U31	IC U32	IC U33	IC U34	PIN NO.	IC U35	PIN NO.	IC U35	PIN NO.	IC U36	IC U37	IC U38	IC U39	IC U40	IC U41
1	H	L	P	H	1	L	21	P	1	H	P(4)	P(4)	H	H(4)	L
2	P	P	P	P	2	H	22	P	2	L	L(4)	P(4)	P(4)	P(4)	P(4)
3	P	P	P	P	3	L	23	P	3	H	*	L(4)	*	*	*
4	P	P	P	P	4	P	24	P	4	H(4)	H(4)	H(4)	*	P(4)	*
5	P	P	P	P	5	P	25	P	5	L(4)	*	H(4)	L(4)	*	P(4)
6	P	P	P	P	6	P	26	*	6	*	P(4)	L(4)	*	P(4)	P(4)
7	P	P	P	P	7	P	27	*	7	L	*	H(4)	*	*	*
8	L	L	P	P	8	P	28	*	8	*	P(4)	H(4)	*	P(4)	*
9	L	P	P	P	9	P	29	*	9	H(4)	*	L(4)	P(4)	*	P(4)
10	L	P	P	L	10	P	30	*	10	P(4)	L	L(4)	H(4)	L	L
11	P	P	P	P	11	P	31	*	11	H(4)	P(4)	H(4)	*	P(4)	P(4)
12	P	P	L	P	12	P	32	*	12	P(4)	*	L(4)	L(4)	*	P(4)
13	P	P	P	P	13	P	33	*	13	H(4)	H(4)	H(4)	*	P(4)	*
14	P	P	P	P	14	P	34	L	14	H	*	H	*	*	*
15	P	P	P	P	15	P	35	P	15		L(4)		L(4)	P(4)	P(4)
16	P	H	P	P	16	L	36	P	16		*		H	*	P(4)
17	P		P	P	17	L	37	P	17		L(4)			L(4)	*
18	L		P	P	18	P	38	P	18		*			*	*
19	L		P	P	19	P	39	P	19		H(4)			H(4)	L(4)
20	H		P	H	20	H	40	P	20		H			H	H
21			L												
22			P												
23			P												
24			H												

PIN NO.	IC U42	IC U43	IC U44	IC U45	IC U46	IC U47	IC U48	IC U49	IC U50	IC U51	IC U52	IC U53	IC U54	IC U55	IC U56
1	H	P	P	H	L	P	P	P	P	P	P	H	P	H	P
2	P	P	P	H	L	P	P	P	P	P	P	P	H	P	P
3	P	P	P	*	L	P	P	P	P	P	P	L	P	P	P
4	H	P	L		P	H	L	L	H	P	P	P	P	P	P
5	H	P	H	H	P	L	L	L	H	P	P	H	P(1)	P	L
6	H	H	L	L	P	P	H	H	P	P	P	H	P	P	H
7	H	L	L	L	L	H	P	P	H	H	H	L	L	P	L
8	L	P	P	P	P	L	L	L	L	L	L	P	H	L	L(4)
9	P	P	P	P	P	H	H	H	H	H	P	H	L	P	H(4)
10	P	P	P	H(4)	P	H	H	H	H	H	*	P	H	P	H(4)
11	P	P	P	L(4)	P	H	H	H	H	H	P	P(4)	P	P	L(4)
12	H	P	L	P	H	H	H	H	H	H	P	P	P	P	H
13	P	L(2)	H	P	H	H	H	H	H	H	P	P	L	P	L
14	P	H	H	H	H	H	H	H	H	H	P	H	H	P	H
15	P				H	H	P	P	H	H	*			P	
16	H				H	H	H	H	H	H	H			H	

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Logic Probe Display

L = Low

H = High

P = Pulse

* = Open (No light On)

(1) Probe indicates L when reverse video feature is not used.

(2) Probe indicates P when underline feature is used.

(4) Logic probe reading taken while running the following program.

10 PRINT "PERSONAL"

20 GOTO 10

MONOCHROME MONITOR/PRINTER ADAPTER LOGIC (Continued)

PIN NO.	IC U57	IC U58	IC U59	IC U60	IC U61	IC U62	IC U63	IC U64	IC U100	IC U101
1	L	H	L	H	P(4)	P	P	L	P	P
2	P	H	L	P	L	L	P	*	H	P
3	H	L	L	P	P	*	P	H	H	P
4	P(4)	*	L	L	H	H	P	*	P	H
5	P(4)	*	H	P	H(4)	P	P	P	P	P
6	H	H	H	L	P(4)	H	P	*	P	P
7	L	L	L	P	H(4)	L	P	P	L	L
8	P(4)	L	P	P	L	P(4)	L	L	P	P
9	P(4)	H	P	P	P(4)	P	P	P	P	P
10	P(4)	H	L	L	H	P	P	L	P	H
11	P	L	P	P	P(4)	P	P	L	H	P
12	P	*	P	*	H	P(4)	L(3)	L(3)	*	P
13	P	*	L	P	P	P(4)	L(3)	P	*	H
14	H	L	H	*	P	H	L	H	H	H
15		H		P	P(4)		P	P		
16		H		*	H		H	H		
17				P				*		
18				*				H		
19				L				L		
20				H				H		

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Logic Probe Display

L = Low

H = High

P = Pulse

* = Open (No light On)

(3) Probe indicates P when highlight (intensity) feature is used.

(4) Logic probe reading taken while running the following program.

10 PRINT "PERSONAL"

20 GOTO 10

PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part Number, and Description

MISCELLANEOUS

ITEM No.	PART NAME	MFGR. PART No.	NOTES
MONOCHROME MONITOR PRINTER ADAPTER			
OSC1	Crystal Adapter	8529148	16.257MHz Monochrome Monitor/Printer

Part Numbers obtained from the IBM
Hardware Maintenance and Service Manual
(Part Number 6025072)
Courtesy of IBM

LINE IDENTIFICATIONS USED AS REFERENCE

INES REDUCE
MULTIPLE LINES

74LS02PC
PART OF U69

See Folder CSCS2.

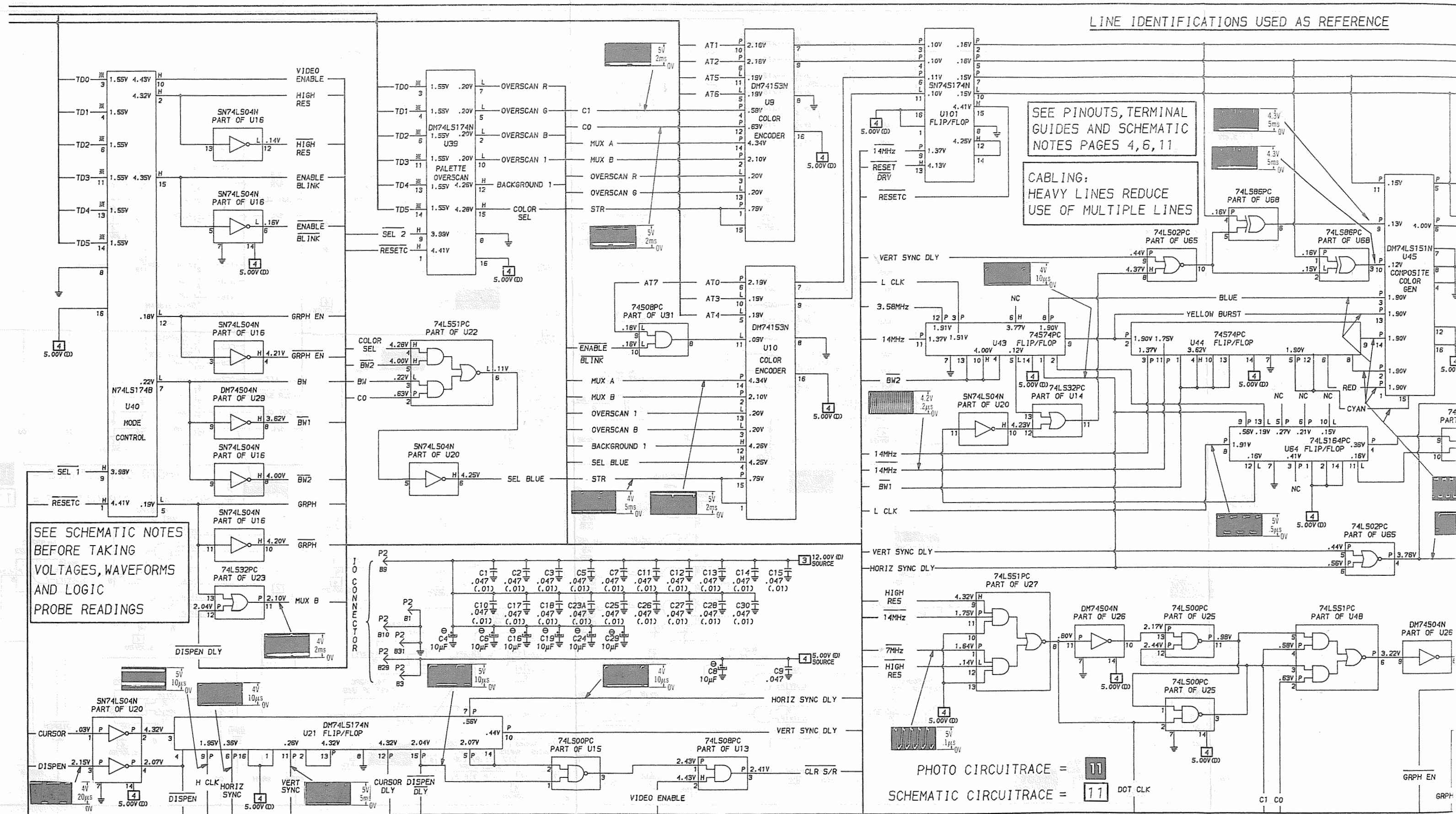
CSCS2-B **IBM**
MODEL 5150

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84CF14923 **DATE 9-84**



A. PHOTOFAC STANDARD NOTATION SCHEMATIC

WITH **CIRCUITRACE**

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COLOR GRAPHIC MONITOR ADAPTER

LINE DEFINITIONS

A0 Thru A13	Address Lines
A15 Thru A19	Address Lines
AEN	Address Enable
AT LATCH	
AT0 Thru AT7	
BA0	Buffered Address
BACKGROUND 1	Color Background One
BLUE	
BMEMR	Buffered Memory Read
BW, BW1, BW2	Buffered Write Lines
C0, C1	Control Lines
CA0 Thru CA11	Column Address Lines
CAS	Column Address Strobe
CAS CC	Column Address Strobe Closed Circuit
CC LATCH	
CC0 Thru CC7	
CCLK	Control Clock
CLK	Clock
CLR S/R	Clear Shift Register
COLOR SEL	Color Select
CPU MEM SEL	Central Processing Unit Memory Select
CS	Chip Select
CURSOR	Cursor Select
CURSOR DLY	Cursor Delay
CYAN	
D0 Thru D7	Data Lines
DATA GATE	Data Gate
DISPEN	Display Enable
DISPEN DLY	Display Enable Delay
DOT CLK	Dot Clock
E	
EN CPU CAS ADDR	Enable Central Processing Unit Column Address Strobe Addr
EN CPU RAS ADDR	Enable Central Processing Unit Row Address Strobe Addr
EN CRT CAS ADDR	Enable CRT Column Address Strobe Addr
EN CRT RAS ADDR	Enable CRT Row Address Strobe Addr
ENABLE BLINK	Enable Blink
GRPH	Graphics
GRPH EN	Graphics Enable

H CLK	Horizontal Clock
HIGH RES	High Resolution
HORIZ SYNC	Horizontal Sync
HORIZ SYNC DLY	Horizontal Sync Delay
I/O CH RDY	I/O Channel Ready
IOR	I/O Read
IOW	I/O Write
L CLK	Light Clock
L PEN INPUT	Light Pen Input
L PEN STR	Light Pen Strobe
L PEN SW	Light Pen Switch
MA0 Thru MA6	Memory Address Lines
MD0 Thru MD7	Memory Data Lines
MEMR	Memory Read
MEMW	Memory Write
MUX A, MUX B	
OSC	Oscillator
OVERSCAN B	Overscan Blue
OVERSCAN G	Overscan Green
OVERSCAN R	Overscan Red
OVERSCAN 1	Overscan Luminance
Q1,Q2,Q4,Q5	Accumulator Extension Lines
RA0 Thru RA2	Read Address Lines
RAS	Row Address Strobe
RD GATE	Read Gate
RED	
RESET C	Reset Control
RESET DRV	Reset Driver
S/L	
SEL BLUE	Select Blue
SEL1, SEL2	Select Lines
STATUS SEL	Status Select
STR	Strobe
TD0 Thru TD7	Transceiver Data Lines
VERT SYNC	Vertical Sync
VERT SYNC DLY	Vertical Sync Delay
VIDEO ENABLE	Video Enable
WE	Write Enable
XACK	Buffered Acknowledge
YELLOW BURST	
3.58MHz	Color Oscillator
7MHz	7MHz Oscillator
14MHz	14MHz Oscillator

Any Bar above any alphabetical or numerical combination indicates line active in a low (0) state.

SCHEMATIC NOTES

- *— Circuitry not used in some versions
- Circuitry used in some versions
- See parts list
- ⊥ Ground
- ≡ Chassis
- ▽ Common tie point

Waveforms and voltages taken from ground, unless noted otherwise.

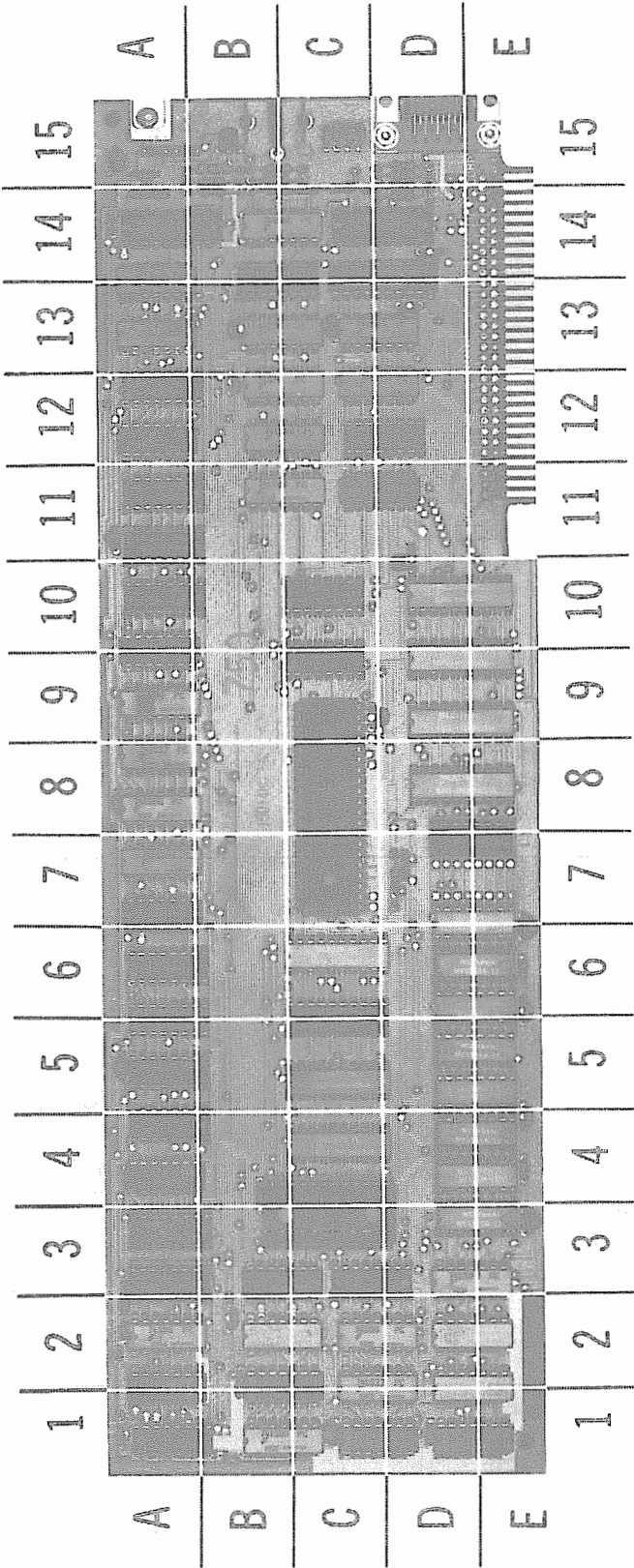
Voltages, Waveforms and Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Waveforms taken with triggered scope and Sweep/Time switch in Calibrate position, scope input set for DC coupling on 0 reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 7 cm. width with DC reference voltage given at the bottom line of each waveform.

Time in μ sec. per cm, given with p-p reading at the end of each waveform.

Item numbers in rectangles appear in the alignment/adjustment instructions.
Supply voltages maintained as shown at input.
Voltages measured with digital meter, no signal.
Controls adjusted for normal operation.
Terminal identification may not be found on unit.
Capacitors are 50 volts or less, 5% unless noted.
Electrolytic capacitors are 50 volts or less, 20% unless noted.
Resistors are 1/2W or less, 5% unless noted.
Value in () used in some versions.
Measurements with switching as shown, unless noted.

Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No light On)

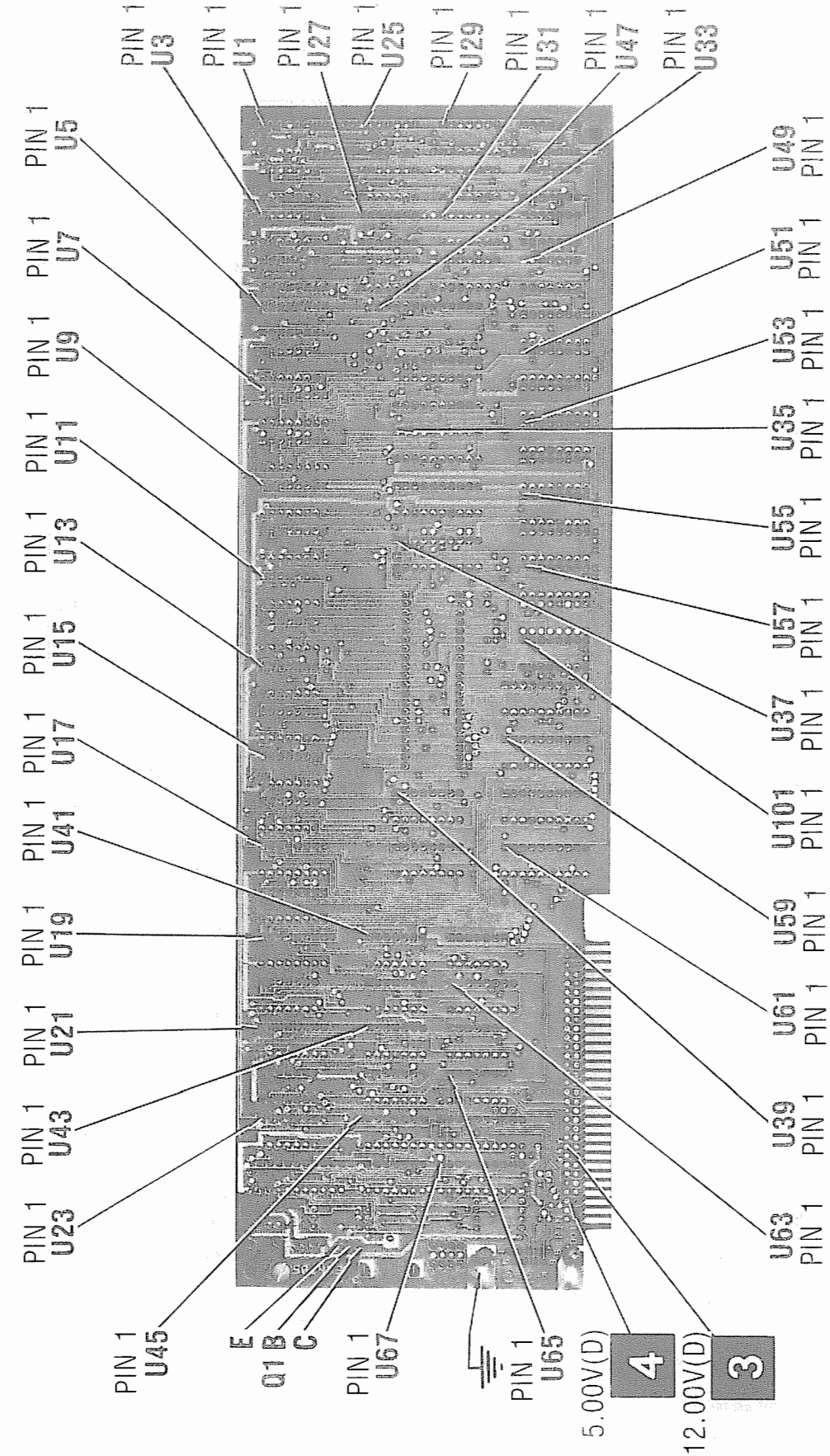
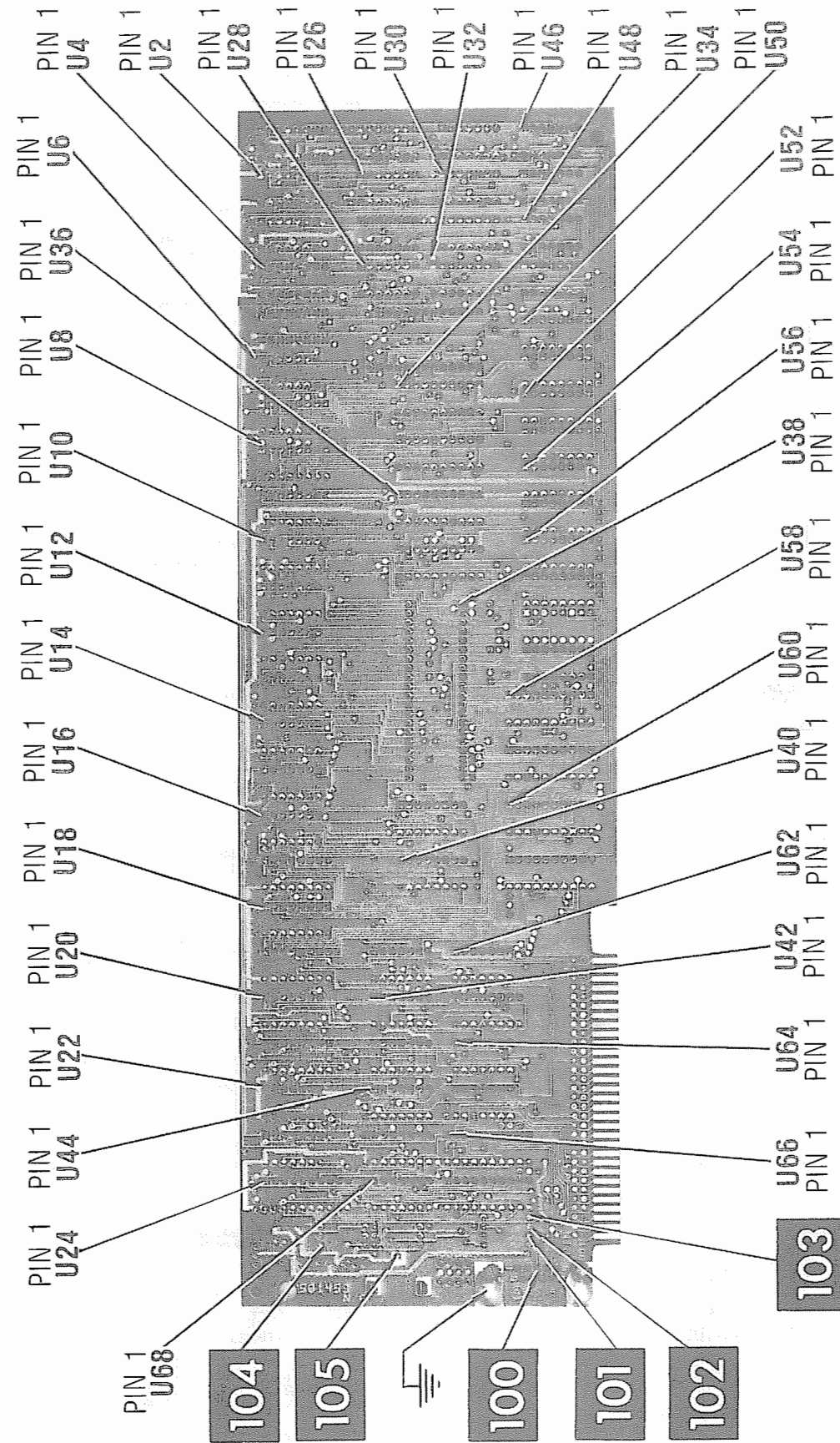


A Howard W. Sams GRIDTRACETM Photo

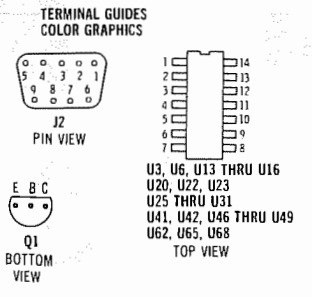
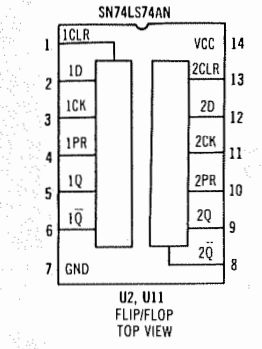
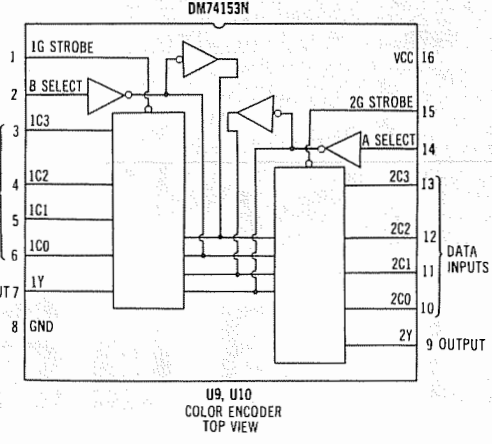
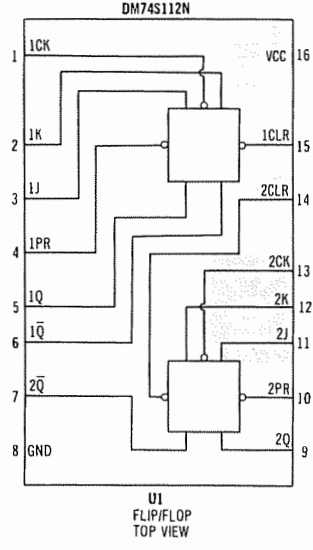
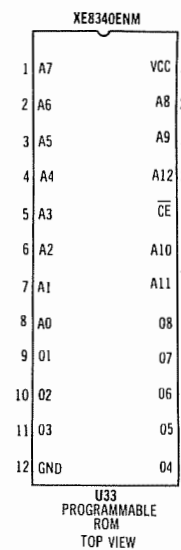
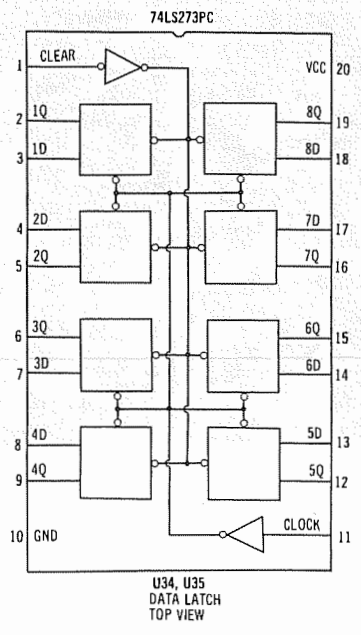
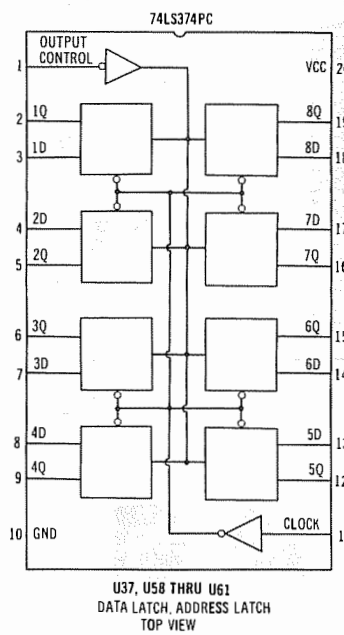
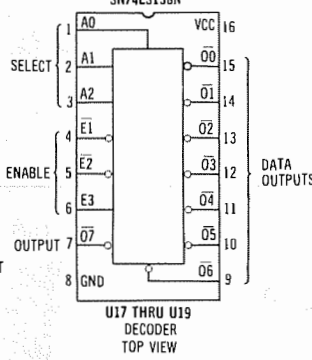
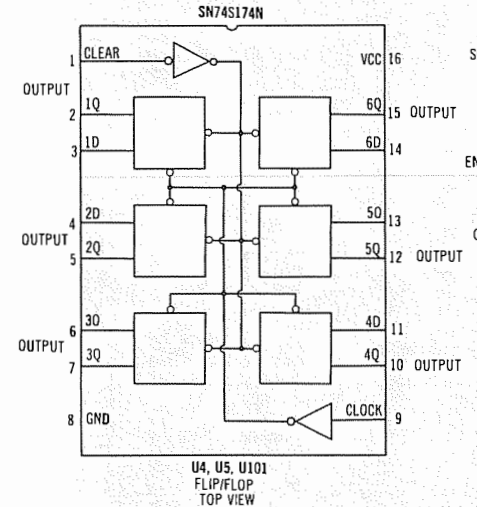
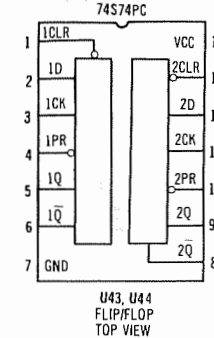
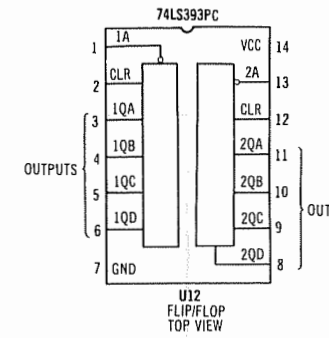
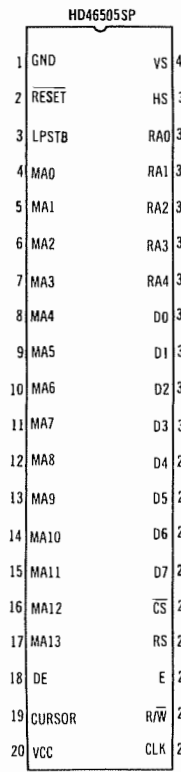
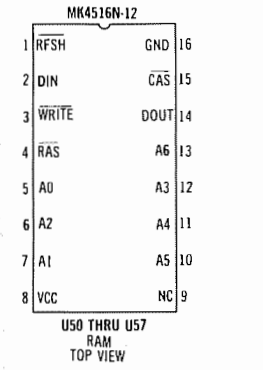
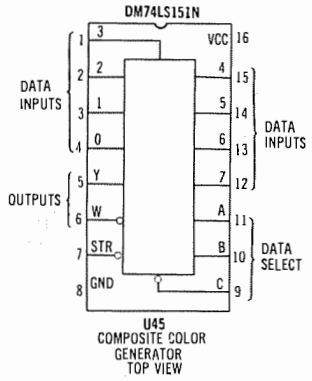
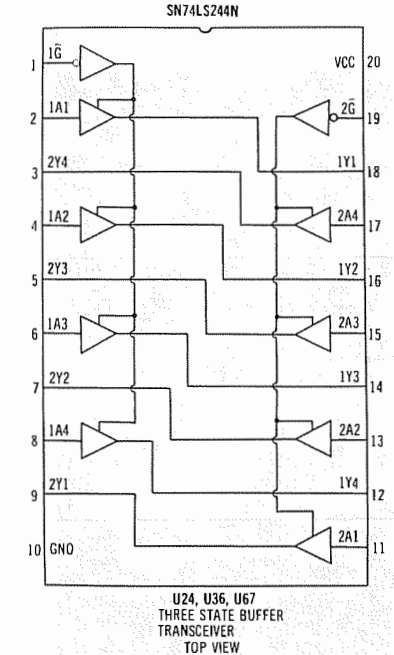
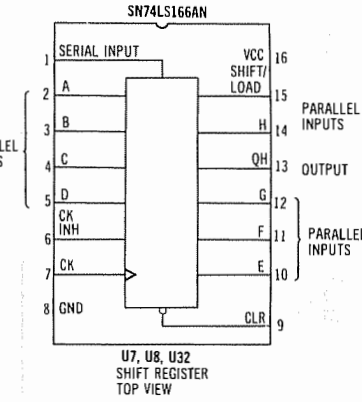
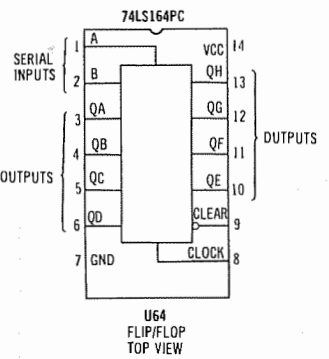
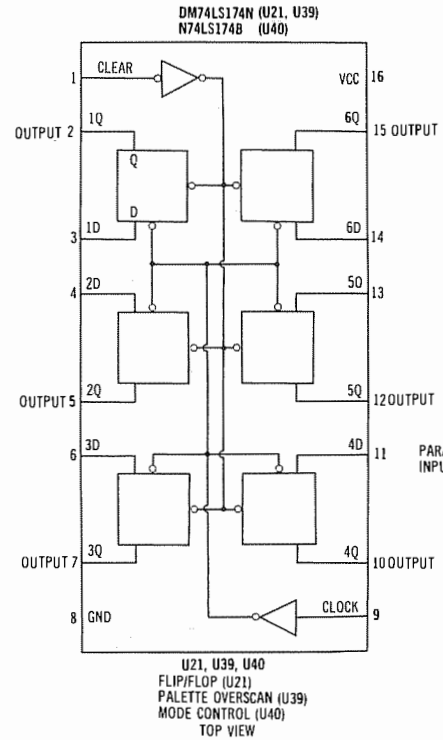
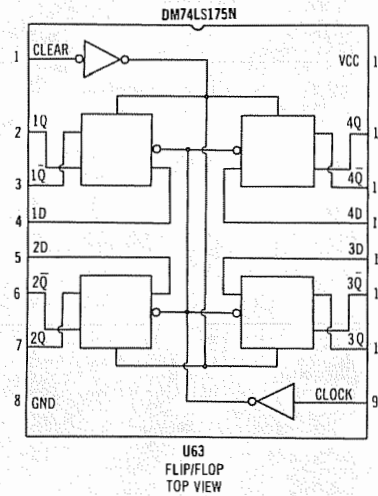
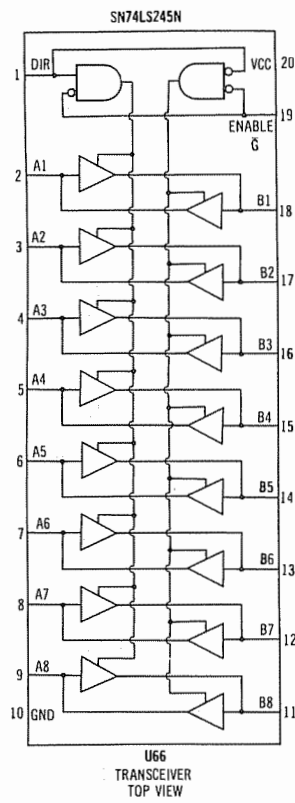
COLOR GRAPHIC MONITOR ADAPTER

COLOR GRAPHIC MONITOR ADAPTER GridTrace LOCATION GUIDE

C1	A-1	C18	D-10	P1	A-14	U3	A-2	U20	A-12	U37	C-6	U54	A-5
C2	A-2	C19	C-13	P2	A-15	U4	A-3	U21	A-12	U38	C-8	U55	A-6
C3	A-2	C20	C-15	Q1	B-15	U5	A-3	U22	A-13	U39	C-9	U56	A-6
C4	A-5	C21	C-15	R1	B-14	U6	A-4	U23	A-14	U40	C-10	U57	D-7
C5	A-8	C22	C-15	R2	D-7	U7	A-4	U24	A-14	U41	B-11	U58	D-8
C6	A-11	C23	C-15	R4	B-15	U8	A-5	U25	B-1	D42	B-12	U59	D-9
C7	A-14	C23A	D-1	R5	B-14	U9	A-5	U26	B-2	U43	B-12	U60	D-9
C8	A-15	C24	E-3	R6	B-15	U10	A-6	U27	B-2	U44	B-13	U61	D-10
C9	A-15	C25	E-4	R7	B-15	U11	A-7	U28	B-3	U45	B-14	U62	D-11
C10	B-1	C26	E-4	R8	C-14	U12	A-7	U29	C-1	U46	B-14	U63	D-11
C11	B-2	C27	E-6	R11	D-15	U13	A-8	U30	C-1	U47	D-1	U64	D-12
C12	B-2	C28	E-6	R12	D-15	U14	A-8	U31	C-2	U48	D-2	U65	D-13
C13	B-4	C29	E-7	R13	D-14	U15	A-9	U32	C-3	U49	D-3	U66	D-14
C14	B-12	C30	D-7	R14	D-14	U16	A-10	U33	C-3	U50	D-3	U67	D-14
C15	B-13	C32	D-14	R17	B-15	U17	A-10	U34	C-4	U51	A-4	U68	B-14
C16	C-1	J1	B-15	U1	A-1	U18	A-11	U35	C-5	U52	A-4	U101	D-7
C17	C-9	J2	D-15	U2	A-1	U19	A-11	U36	C-5	U53	A-5		



IC PINOUTS & TERMINAL GUIDES



COLOR GRAPHIC MONITOR ADAPTER

COLOR GRAPHIC MONITOR ADAPTER

IBM
MODEL 5150

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS

ITEM No.	TYPE No.	MFGR. PART No.	ITEM No.	TYPE No.	MFGR. PART No.
COLOR GRAPHIC MONITOR ADAPTER					
Q1	2N3904		U32	SN74LS166AN	
U1	DM74S112N		U33	XE8340ENM	
U2	SN74LS74AN			MK36000	
U3	74S86PC		U34,35	74LS273PC	
U4,5	SN74S174N		U36	SN74LS244N	
U6	SN74LS04N		U37	74LS374PC	
U7,8	SN74LS166AN		U38	HD46505SP	
U9,10	DM74153N			HD6845SP	
U11	SN74LS74AN		U39	DM74LS174N	
U12	74LS393PC		U40	N74LS174B	
U13	74LS08PC		U41	74LS08PC	
U14	74LS32PC		U42	74LS86PC	
U15	74LS00PC		U43,44	74S74PC	
U16	SN74LS04N		U45	DM74LS151N	
U17	SN74LS138N		U46	DM74LS00N	
thru			U47,48	74LS51PC	
U19			U49	74LS02PC	
U20	SN74LS04N		U50	MK4516N-12	
U21	DM74LS174N		thru	2118-4	
U22	74LS51PC		U57		
U23	74LS32PC		U58	74LS374PC	
U24	SN74LS244N		thru		
U25	74LS00PC		U61	SNJ54LS125AJ	
U26	DM74S04N		U62	54LS125A/BCBJC	
U27	74LS51PC		U63	DM74LS175N	
U28	SN74LS10ND		U64	74LS164PC	
U29	DM74S04N		U65	74LS02PC	
U30	74LS32PC		U66	SN74LS245N	
U31	74S08PC		U67	SN74LS244N	
			U68	74LS86PC	
			U101	SN74S174N	

ELECTROLYTIC

CAPACITORS Item numbers not listed are normally available at local distributors.

ITEM No.	RATING	MFGR. PART No.	ITEM No.	RATING	MFGR. PART No.
COLOR GRAPHIC MONITOR ADAPTER					
C4	10 16V 10%		C16	10 16V 10%	
C6	10 16V 10%		C19	10 16V 10%	
C8	10 16V 10%		C24	10 16V 10%	
			C29	10 16V 10%	

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA	
		MFGR. PART No.	NOTES
COLOR GRAPHIC MONITOR ADAPTER			
R1	100 1½ 1/4W Carbon Film		

COLOR GRAPHIC MONITOR ADAPTER LOGIC

PIN NO.	IC U1	IC U2	IC U3	IC U4	IC U5	IC U6	IC U7	IC U8	IC U9	IC U10	IC U11	IC U12	IC U13	IC U14	IC U15
1	P	H	P	H	H	P	L	L	P	P	H	P	P	H	P
2	P	H	P	P	P	P	P	L	P	P	H	L	H	P	P
3	P	P	P	P	P	P	P	L	L	L	L	P	P	H	P
4	H	H	P	P	P	P	L	L	L	L	H	P	*	H	*
5	P	H	P	P	P	P	L	L	L	L	L	P	*	P	*
6	P	L	L	P	P	P	L	L	P	P	L	L	H	P	L
7	P	L	L	P	P	L	L	L	L	L	L	L	H	L	L
8	L	L	L	L	L	L	L	L	L	L	L	L	H	L	L
9	P	H	P	P	P	P	P	P	P	L	P	P	H	P	H
10	H	L	P	P	P	P	P	P	P	L	H	P	H	H	H
11	P	P	P	P	P	P	P	P	L	L	P	P	H	H	L
12	P	H	P	P	P	P	P	P	P	H	P	L	H	H	L
13	P	H	P	P	P	H	P	P	L	L	P	H	H	L	P
14	H	H	H	P	P	H	P	P	P	P	H	H	H	H	H
15	H			P	P		P	P	P	P					
16	H			H	H		H	H	H	H					
PIN NO.	IC U16	IC U17	IC U18	IC U19	IC U20	IC U21	IC U22	IC U23	IC U24	IC U25	IC U26	IC U27	IC U28	IC U29	IC U30
1	P	P	P	P	P	H	P	P	L	P	P	P	H	P	P
2	P	P	P	P	P	P	P	P	P	P	P	P	H	P	P
3	L	P	P	P	P	P	L	P	*	P	P	P	L	*	P
4	H	P	P	P	P	P	H	P	P	*	P	L	P	L	P
5	H	P	P	P	L	P	H	H	*	*	H	P	P	H	H
6	L	P	P	P	H	P	L	L	L	L	L	P	H	L	L
7	L	H	L	L	L	P	L	L	*	L	L	L	L	L	L
8	H	L	L	L	L	L	L	L	P	L	L	L	H	L	L
9	L	H	P	H	L	P	H	P	*	H	P	H	P	L	L
10	H	H	P	H	L	P	H	P	L	P	P	H	L	L	P
11	L	H	P	H	L	P	P	P	P	P	P	L	L	L	H
12	L	H	P	H	L	P	P	P	P	P	P	L	L	L	H
13	H	H	P	H	P	P	L	L	*	P	P	H	H	P	P
14	H	H	P	H	H	P	L	L	L	L	H	H	H	H	H
15		H	P	H		P									
16		H	H	H		P									
17									P						
18									P						
19									H						
20									H						

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No light On)

CSCS2-B
MODEL 5150

IBM

COLOR GRAPHIC MONITOR ADAPTER LOGIC (Continued)

PIN NO.	IC U31	IC U32	IC U33	IC U34	IC U35	IC U36	IC U37	PIN NO.	IC U38	PIN NO.	IC U38	PIN NO.	IC U39	IC U40	IC U41
1	P	L	P	H	P	H	H	1	L	21	P	1	H	H	P
2	P	L	P	L	L	*	*	2	H	22	P	2	L	H	P
3	P	P	P	L	L	L	P	3	L	23	P	3	*	*	P
4	*	P	P	P	P	*	P	4	P	24	P	4	*	*	H
5	*	P	P	P	L	P	*	5	P	25	P	5	L	L	P
6	H	L	P	P	L	*	*	6	P	26	*	6	*	*	P
7	L	L	P	P	P	P	P	7	P	27	*	7	L	L	L
8	L	L	P	P	P	*	P	8	P	28	*	8	L	L	P
9	L	P	L	P	L	P	*	9	P	29	*	9	H	H	P
10	L	P	P	L	L	L	L	10	P	30	*	10	L	H	P
11	H	P	P	P	L	*	L	11	P	31	*	11	*	*	P
12	*	P	L	P	L	P	*	12	P	32	*	12	H	L	P
13	*	P	P	P	P	*	P	13	P	33	*	13	*	*	P
14	H	P	P	P	P	*	P	14	P	34	L	14	*	*	H
15		P	P	P	P	*	*	15	P	35	L	15	H	H	
16		H	P	P	P	*	*	16	L	36	P	16	H	H	
17			P	P	P	*	P	17	L	37	P				
18			H	P	P	H	L	18	P	38	P				
19			L	P	P	H	*	19	P	39	P				
20					H	H	H	20	H	40	P				
21															
22			H												
23			P												
24			P												
			H												
PIN NO.	IC U42	IC U43	IC U44	IC U45	IC U46	IC U47	IC U48	IC U49	IC U50	IC U51	IC U52	IC U53	IC U54	IC U55	IC U56
1	P	P	H	P	L	L	P	L	*	*	*	*	*	*	*
2	P	L	P	P	P	L	P	L	L	P	P	P	P	P	P
3	P	P	P	P	H	H	P	H	H	H	H	H	H	H	H
4	P	H	H	L	L	P	P	P	P	P	P	P	P	P	P
5	P	L	P	P	P	L	P	P	P	P	P	P	P	P	P
6	P	H	P	P	H	L	P	P	P	P	P	P	P	P	P
7	L	L	L	L	L	L	H	L	H	H	H	H	H	H	H
8	P	P	P	P	P	P	L	H	*	*	*	*	*	*	*
9	P	P	P	P	H	H	L	H	P	P	P	P	P	P	P
10	L	H	H	P	P	H	H	L	P	P	P	P	P	P	P
11	P	P	P	H	H	P	L	P	P	P	P	P	P	P	P
12	P	P	P	H	H	P	H	P	P	P	P	P	P	P	P
13	L	H	H	P	P	H	H	P	P	P	P	P	P	P	P
14	H	H	H	P	H	H	H	H	L	P	P	P	P	P	P
15				P					P	P	P	P	P	P	P
16				H					L	P	L	L	L	L	L

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
 Logic Probe Display
 L = Low
 H = High
 P = Pulse
 * = Open (No light On)

COLOR GRAPHIC MONITOR ADAPTER LOGIC (Continued)

PIN NO.	IC U57	IC U58	IC U59	IC U60	IC U61	IC U62	IC U63	IC U64	IC U65	IC U66	IC U67	IC U68	IC U101
1	*	P	P	H	H	P	P	H	L	P	P	P	H
2	P	P	P	P	P	P	P	H	P	P	P	P	P
3	H	P	P	P	P	P	P	P	P	P	P	P	P
4	P	P	P	P	P	H	H	P	P	P	P	P	P
5	P	P	P	P	P	L	P	P	P	P	P	L	P
6	P	P	P	P	P	H	P	P	P	P	P	P	P
7	P	P	P	P	P	L	P	P	P	P	P	P	P
8	H	P	P	P	P	L	P	P	P	P	P	P	P
9	*	P	P	P	P	P	P	P	P	P	P	P	P
10	P	L	L	L	L	L	P	P	L	L	L	P	P
11	P	P	P	P	P	P	P	P	*	*	*	P	P
12	P	P	P	P	P	P	P	L	*	*	*	P	P
13	P	P	P	P	P	L	P	L	*	*	*	P	P
14	P	L	P	P	P	H	P	H	*	*	*	P	P
15	P	P	P	P	P		P		*	*	*	P	P
16	L	H	P	P	P		H		*	*	*	P	P
17		*	P	P	P				*	*	*	P	P
18		H	*	*	*				*	*	*	P	P
19		H	H	H	H				H	H	H	L	H
20		H	H	H	H				H	H	H		

NOTE: Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.
 Logic Probe Display
 L = Low
 H = High
 P = Pulse
 * = Open (No light On)

PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part Number, and Description

MISCELLANEOUS

ITEM No.	PART NAME	MFR. PART No.	NOTES
	COLOR GRAPHIC MONITOR ADAPTER		
	Adapter	8529146	Color Graphic Monitor

Part Numbers obtained from the IBM
 Hardware Maintenance and Service Manual
 (Part Number 6025072)
 Courtesy of IBM

E-12
E-13

U29
U30

E-3
E-4
E-5
E-6
E-7

U20
U21
U22
U23
U24

C-5
C-12
C-9
C-10
C-11

U1
U12
U13
U14
U15

A-3
A-5
A-6
A-7
A-8

U2
U3
U4
U5
U6

B-1
A-15
F-2
F-3
F-4

P2
R1
R2
R3
R4

E-6
E-8
E-10
F-3
F-10

C14
C15
C16
C17
C18

B-14
C-3
C-4
C-6
C-8

S-5
S-7
S-8
S-8

IBM
MODEL 5150

LINE DEFINITIONS

A0 Thru A9	Address Lines	MOTOR ON	Motor On
AEN	Address Enable	MR	Memory Read
CLK	Clock	OUT	Output
CLR	Clear	READ DATA	Read Data
CPI	Clock Pulse	READ DATA (A & B)	Read Data (Disk Drive A and B)
D0 Thru D7	Data Lines	READ DATA (C & D)	Read Data (Disk Drive C and D)
DACK	Direct Memory Address Acknowledge	RESET	Reset
DACK & TC	Direct Memory Address Acknowledge	SEEK	Seek
DACK 2	Direct Memory Address Acknowledge Two	SELECT HEAD 1(A & B)	Select Head One(Disk Drive A and B)
DIR (A & B)	Direction (Disk Drive A and B)	SELECT HEAD 1(C & D)	Select Head One(Disk Drive C and D)
DIR (C & D)	Direction (Disk Drive C and D)	S0	Side 0
DMA	Direct Memory Address	S1	Side One
DRIVE SELECT (A)	Drive Select (Disk Drive A)	STEP (A & B)	Step (Disk Drive A and B)
DRIVE SELECT (B)	Drive Select (Disk Drive B)	STEP (C & D)	Step (Disk Drive C and D)
DRIVE SELECT (C)	Drive Select (Disk Drive C)	TC	
DRIVE SELECT (D)	Drive Select (Disk Drive D)	TRACK 0	Track 0
DRQ2	Data Request Two	TRACK 0 (A & B)	Track 0 (Disk Drive A and B)
ENABLE DRIVE (C & D)	Enable Drive (Disk Drive C and D)	TRACK 0 (C & D)	Track 0 (Disk Drive C and D)
ERASE	Erase	VCO SYNC	Voltage Controlled Oscillator Sync
HM		WR DATA (A & B)	Write Data (Disk Drive A and B)
INDEX	Index	WR DATA (C & D)	Write Data (Disk Drive C and D)
INDEX (A & B)	Index (Disk Drive A and B)	WRITE	Write
INDEX (C & D)	Index (Disk Drive C and D)	WRITE DATA 00	
INT WRT BUSY	Interrupt Write Busy	WRITE DATA 01	
INIT	Initialize	WRITE GATE (A & B)	Write Gate (Disk Drive A and B)
IOR	Input/Output Read	WRITE GATE (C & D)	Write Gate (Disk Drive C and D)
IOW	Input/Output Write	WRITE PROTECT	Write Protect
IRQ	Interrupt Request	WRITE PROTECT (A & B)	Write Protect (Disk Drive A and B)
MOTOR ENABLE (A)	Motor Enable (Disk Drive A)	WRITE PROTECT (C & D)	Write Protect (Disk Drive C and D)
MOTOR ENABLE (B)	Motor Enable (Disk Drive B)	WRT TRAN	
MOTOR ENABLE (C)	Motor Enable (Disk Drive C)	2MHz	Clock Frequency
MOTOR ENABLE (D)	Motor Enable (Disk Drive D)	16MHz	System Clock

Any Bar above any alphabetical or numerical combination indicates line active in a low (0) state.

SCHEMATIC NOTES

- ⚡ Circuitry not used in some versions
- Circuitry used in some versions
- See parts list
- ⊕ Ground
- ⏏ Chassis
- △ Common tie point

Waveforms and voltages taken from ground, unless noted otherwise.

Voltages, Waveforms and Logic probe readings taken with computer turned On, no keys pressed, unless otherwise noted.

Waveforms taken with triggered scope and Sweep/Time switch in Calibrate position, scope input set for DC coupling on 0 reference voltage waveforms. Switch to AC input to view waveforms after DC reference is measured when necessary. Each waveform is 7 cm. width with DC reference voltage given at the bottom line of each waveform.

Time in μ sec. per cm, given with p-p reading at the end of each waveform.

Item numbers in rectangles appear in the alignment/adjustment instructions.

Supply voltages maintained as shown at input.

Voltages measured with digital meter, no signal.

Controls adjusted for normal operation.

Terminal identification may not be found on unit.

Capacitors are 50 volts or less, 5% unless noted.

Electrolytic capacitors are 50 volts or less, 20% unless noted.

Resistors are $\frac{1}{2}$ W or less, 5% unless noted.

Value in () used in some versions.

Measurements with switching as shown, unless noted.

NOTE: Voltages, waveforms and logic probe readings taken on Disk Drive B while running the following Basic program. Readings taken while the Head Position Motor (M2) is not operating unless otherwise noted. A diskette formatted for doubled sided use was used. Diskette was not write protected. Disk Drive A and B have the same voltages, logic probe readings and waveforms unless otherwise noted.

10 OPEN "B:SAMS.DAT" FOR OUTPUT AS #1
20 FOR X = 1 TO 300
30 PRINT #1, "THIS IS A TEST"
40 NEXT X
50 CLOSE #1
60 GOTO 10

Logic Probe Display

L = Low

H = High

P = Pulse

* = Open (No light On)

- (1) Probe indicates L when Head is on track 00 and H when off track 00.
- (2) Probe indicates P when Head Position Motor is operating.
- (3) Probe indicates H when Head is on track 00 and L when off track 00.
- (4) Probe indicates H when Head is moving in and L when Head is moving out from center of diskette.
- (5) Probe indicates L when Head is moving in and H when Head is moving out from center of diskette.
- (6) Probe indicates H if diskette is write protected.
- (7) Probe indicates L if diskette is write protected.
- (8) Probe reading not taken for IC U1 on Servo Board and ICs 3A, 4A and pins 2, 3, 5, 6 and 8 of 5B on Disk Drive Board.

SAMS

COMPUTERFACTS™

IBM
MODEL 5150

DISK DRIVE ADAPTER, DISK DRIVES (A & B) TYPE 1

KEYBOARD, SYSTEM BOARD, PRINTER ADAPTER, POWER SUPPLY

See Folder CSCS2.

IBM
MODEL 5150
CSCS2-C

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SAMS

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The listing of any available replacement part herein does not constitute in any case a recommendation, warranty or guaranty by Howard W. Sams & Co., Inc., as to the quality and suitability of such replacement part. The numbers of these parts have been compiled from information furnished to Howard W. Sams & Co., Inc., by the manufacturers of the particular type of replacement part listed.

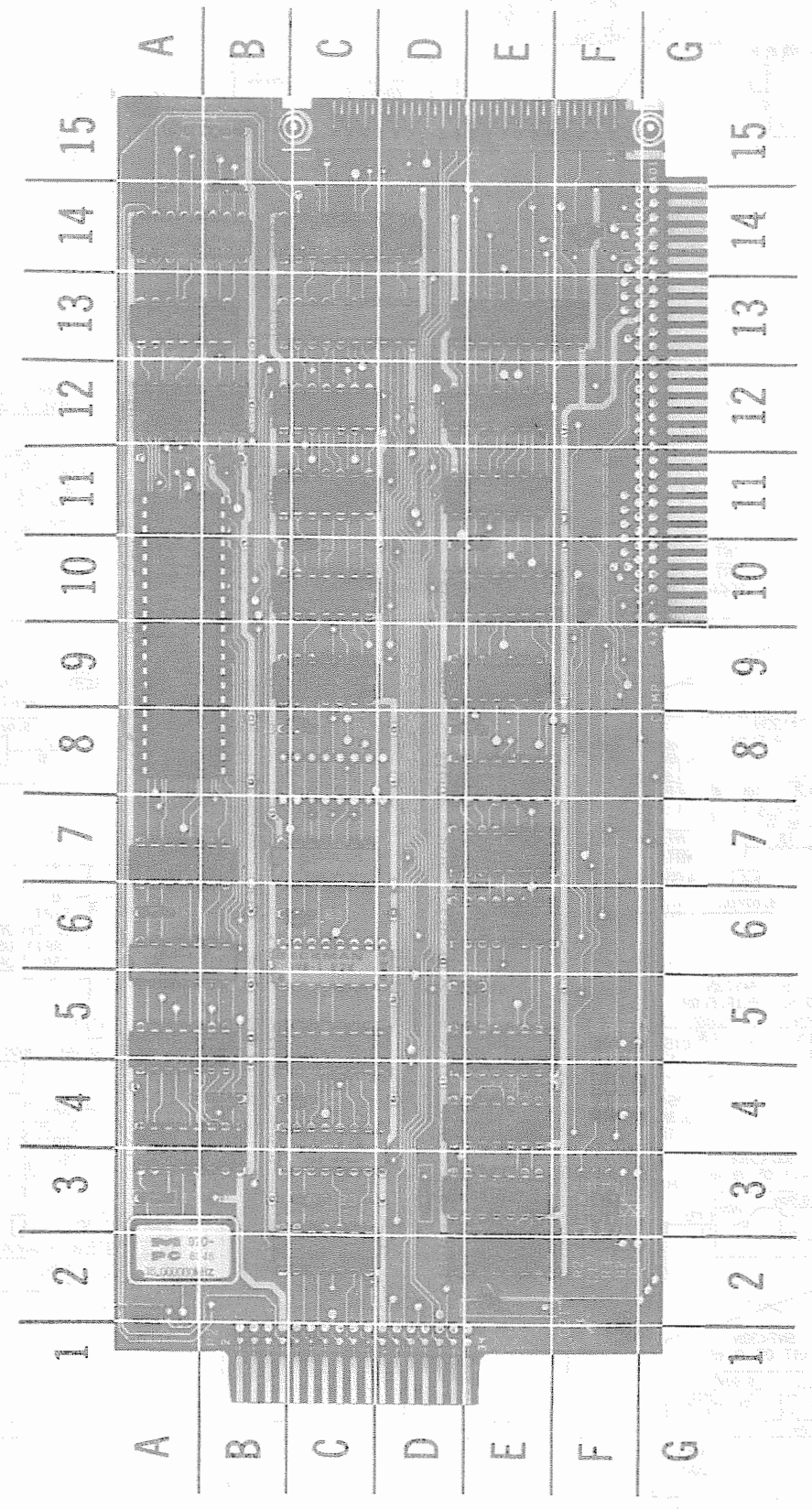
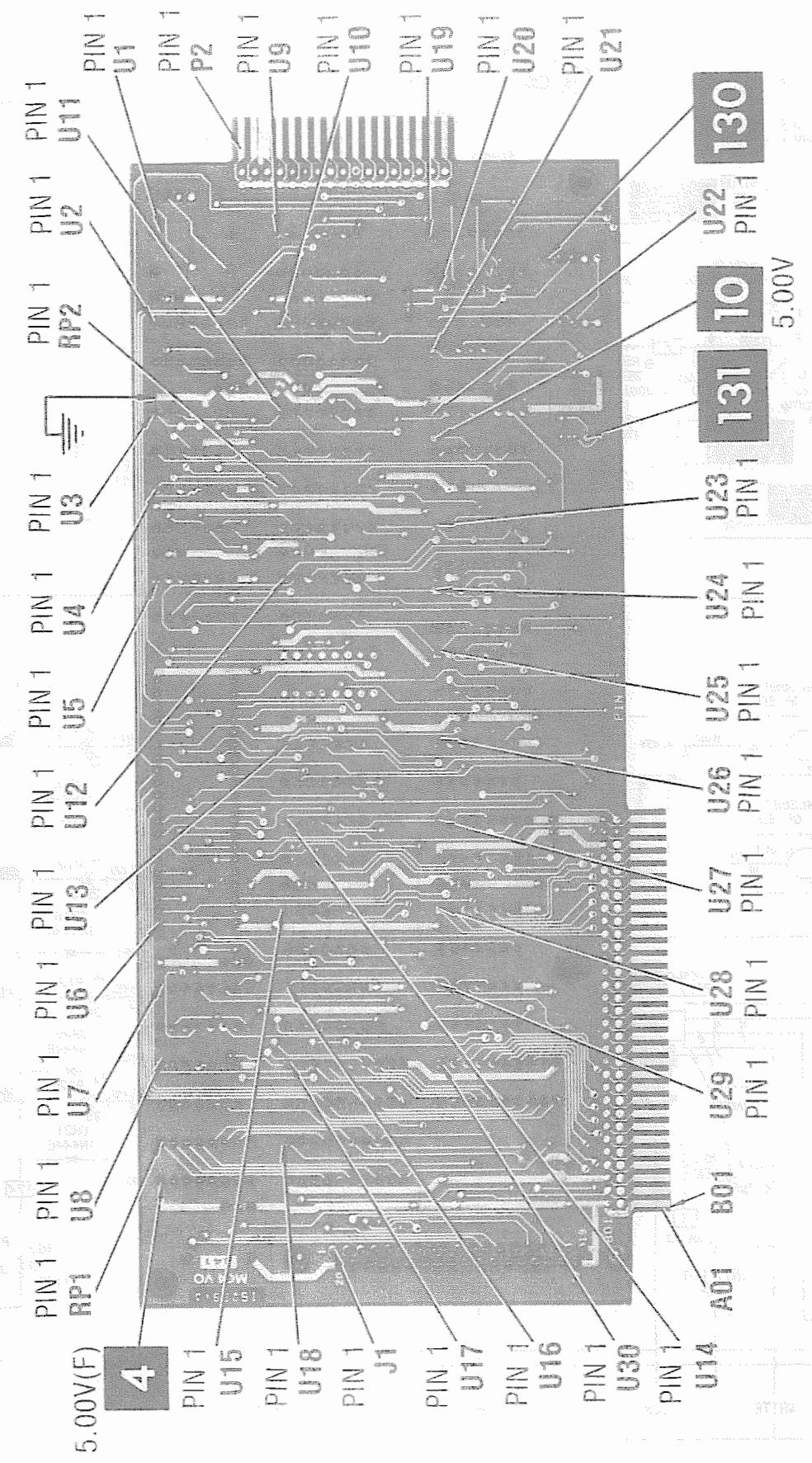
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DATE 9-84



DISK DRIVE ADAPTER GridTrace LOCATION GUIDE

C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C19	F-14	R5	F-4	U7	A-12	U16	C-12	U25
A-3	B-4	A-6	B-11	B-14	C-3	C-4	C-6	C-8	D-3	C20	G-4	RP1	A-14	U8	A-13	U17	C-13	E-8
									E-4	C21	E-2	RP2	C-6	U9	C-2	U18	C-14	E-9
									E-5	J1	D-15	U1	C-2	U10	C-3	U19	E-2	E-10
									E-6	P2	B-1	U2	A-3	U11	C-5	U20	E-3	E-11
									E-8	R1	A-15	U3	A-5	U12	C-12	U21	E-4	E-12
									E-10	R2	F-2	U4	A-6	U13	C-9	U22	E-5	E-13
									F-3	R3	F-3	U5	A-7	U14	C-10	U23	E-6	
									F-10	R4	F-4	U6	A-8	U15	C-11	U24	E-7	

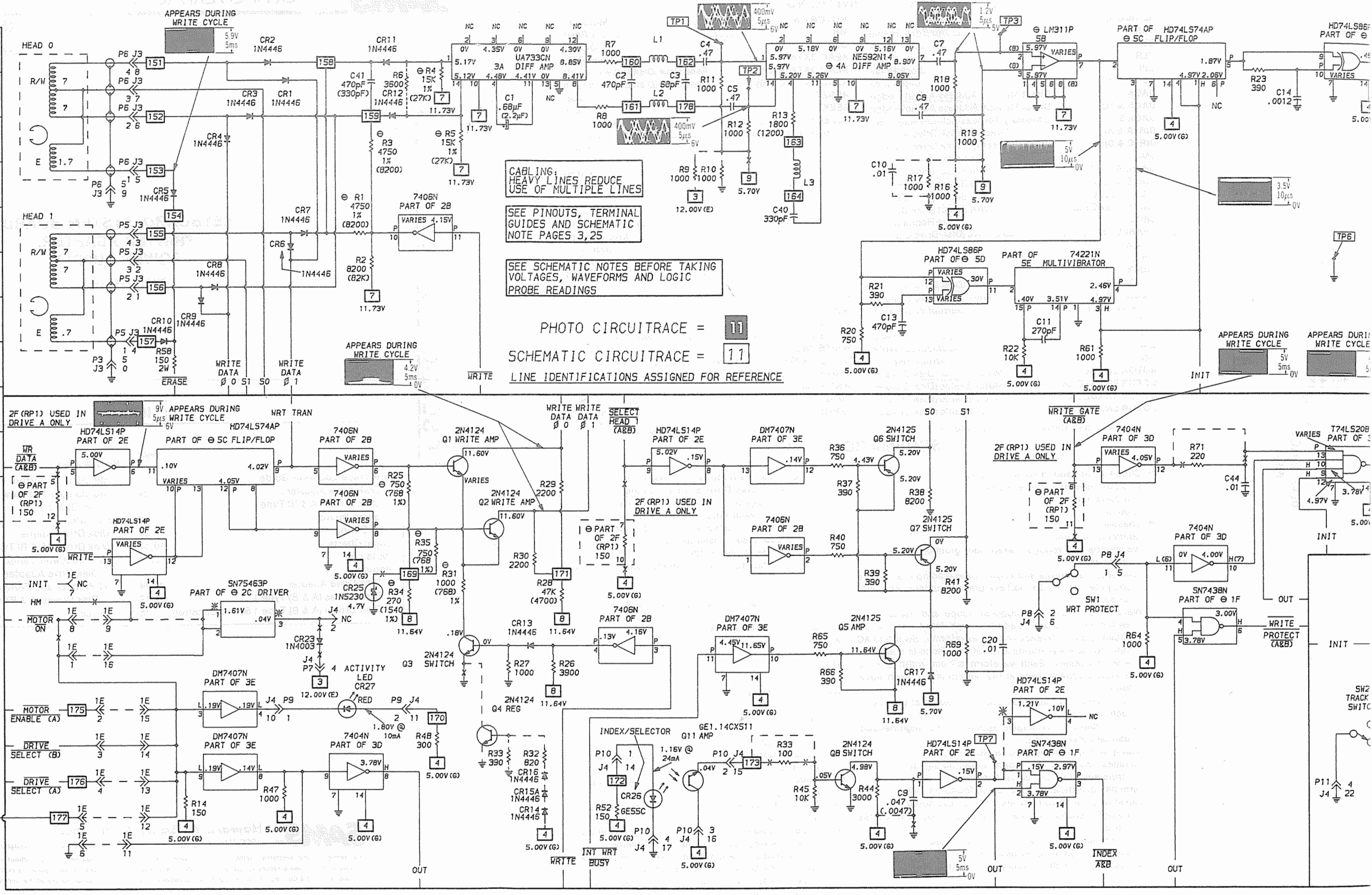
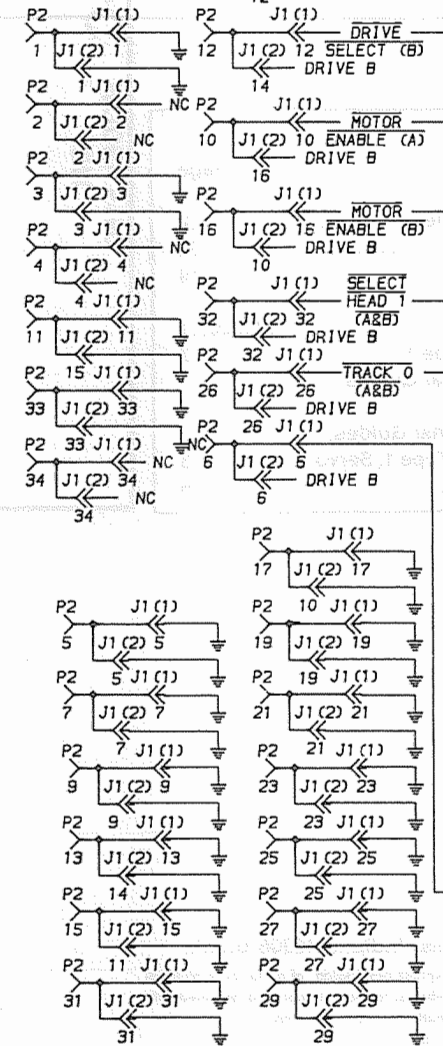
IBM
MODEL 5150

- A0 Thru A9
 - AEN
 - CLK
 - CLR
 - CPI
 - D0 Thru D7
 - DACK
 - DACK & TC
 - DACK 2
 - DIR (A & B)
 - DIR (C & D)
 - DMA
 - DRIVE SELECT (A)
 - DRIVE SELECT (B)
 - DRIVE SELECT (C)
 - DRIVE SELECT (D)
 - DRQ2
 - ENABLE DRIVE (C & D)
 - ERASE
 - HM
 - INDEX
 - INDEX (A & B)
 - INDEX (C & D)
 - INT WRT BUSY
 - INIT
 - IOR
 - IOW
 - IRQ
 - MOTOR ENABLE (A)
 - MOTOR ENABLE (B)
 - MOTOR ENABLE (C)
 - MOTOR ENABLE (D)
- Any Bar above any alphabet

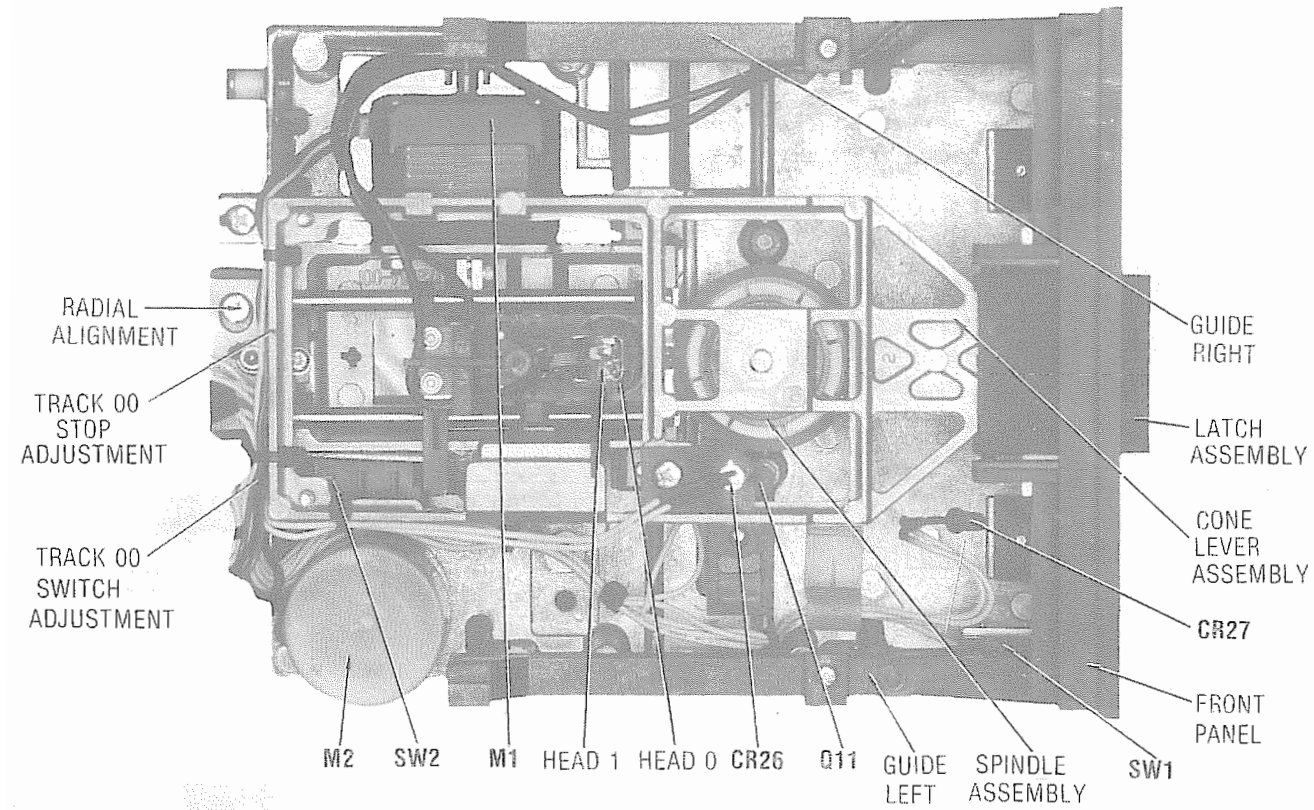
- Circuitry not used in some versions
- Circuitry used in some versions
- See parts list
- Ground
- Chassis
- Common tie point
- Waveforms and voltages taken from otherwise.
- Voltages, Waveforms and Logic pre computer turned On, no keys pre noted.
- Waveforms taken with triggered switch in Calibrate position, s coupling on 0 reference voltage w input to view waveforms after D when necessary. Each waveform reference voltage given at the bc form.
- Time in μ sec. per cm, given with p each waveform.
- Item numbers in rectangles appe justment instructions.
- Supply voltages maintained as sho
- Voltages measured with digital me
- Controls adjusted for normal opera
- Terminal identification may not be
- Capacitors are 50 volts or less, 5%
- Electrolytic capacitors are 50 volt noted.
- Resistors are $\frac{1}{2}$ W or less, 5% unle
- Value in () used in some versions.
- Measurements with switching as s

FROM DISK ADAPTER

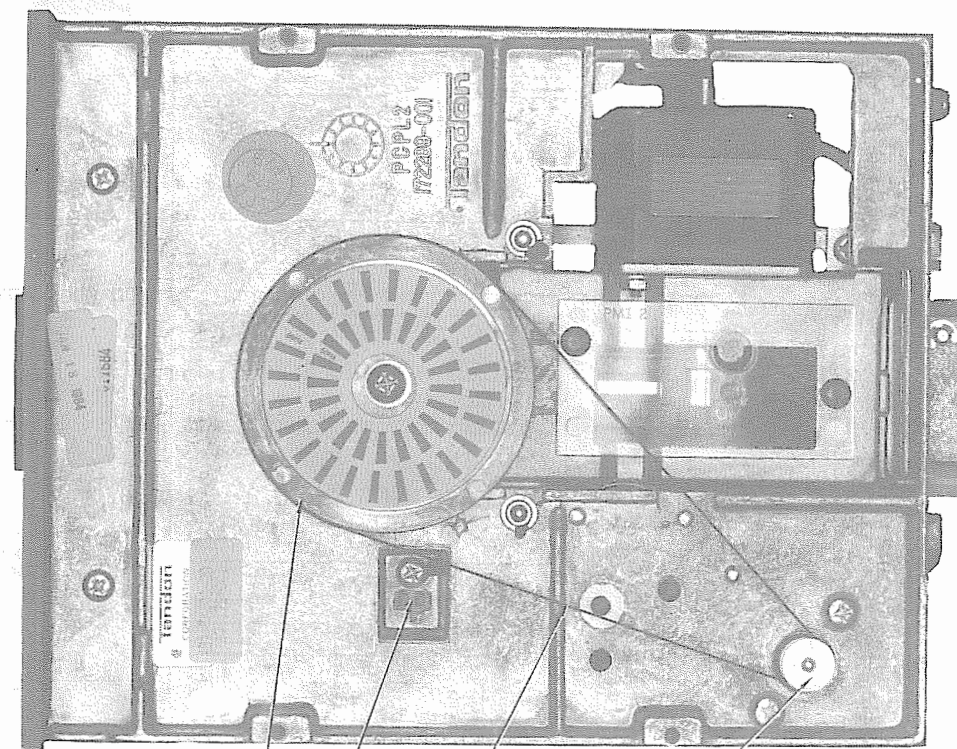
SEE P2 ON DISK DRIVE ADAPTER BOARD PAGE 5



IC PINOUTS & TERMINAL GUIDES

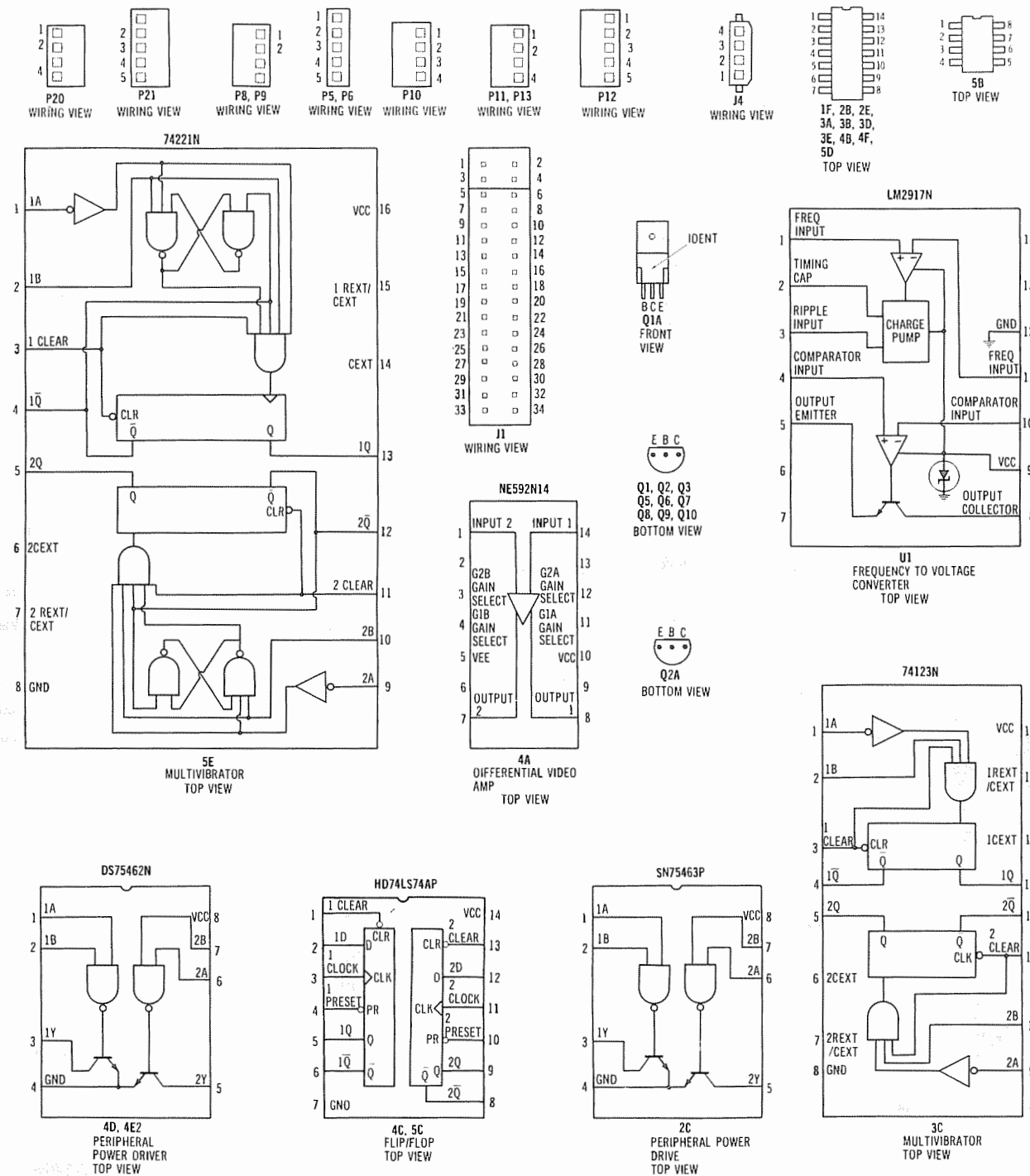


MECHANICAL-TOP VIEW



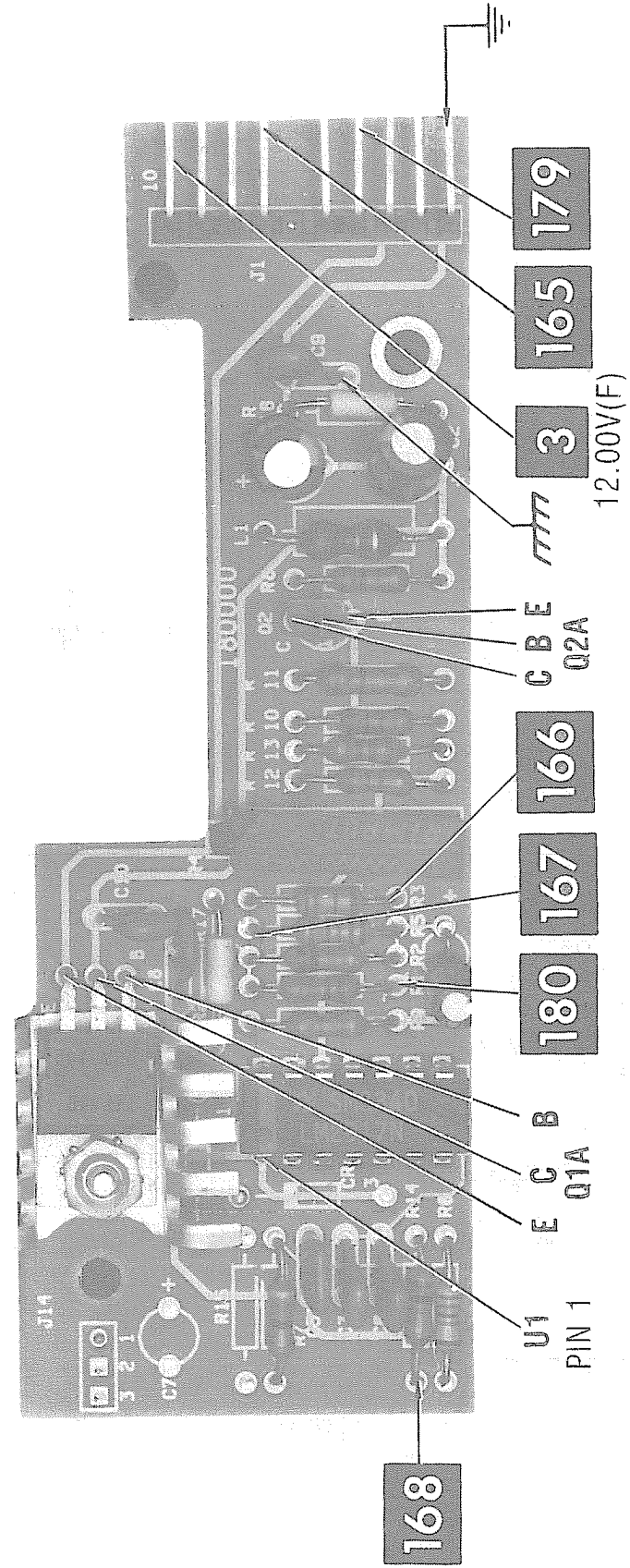
MECHANICAL-BOTTOM VIEW

FLYWHEEL	INDEX	DRIVE	MOTOR
	SENSOR	BELT	PULLEY
	ADJUSTMENT		

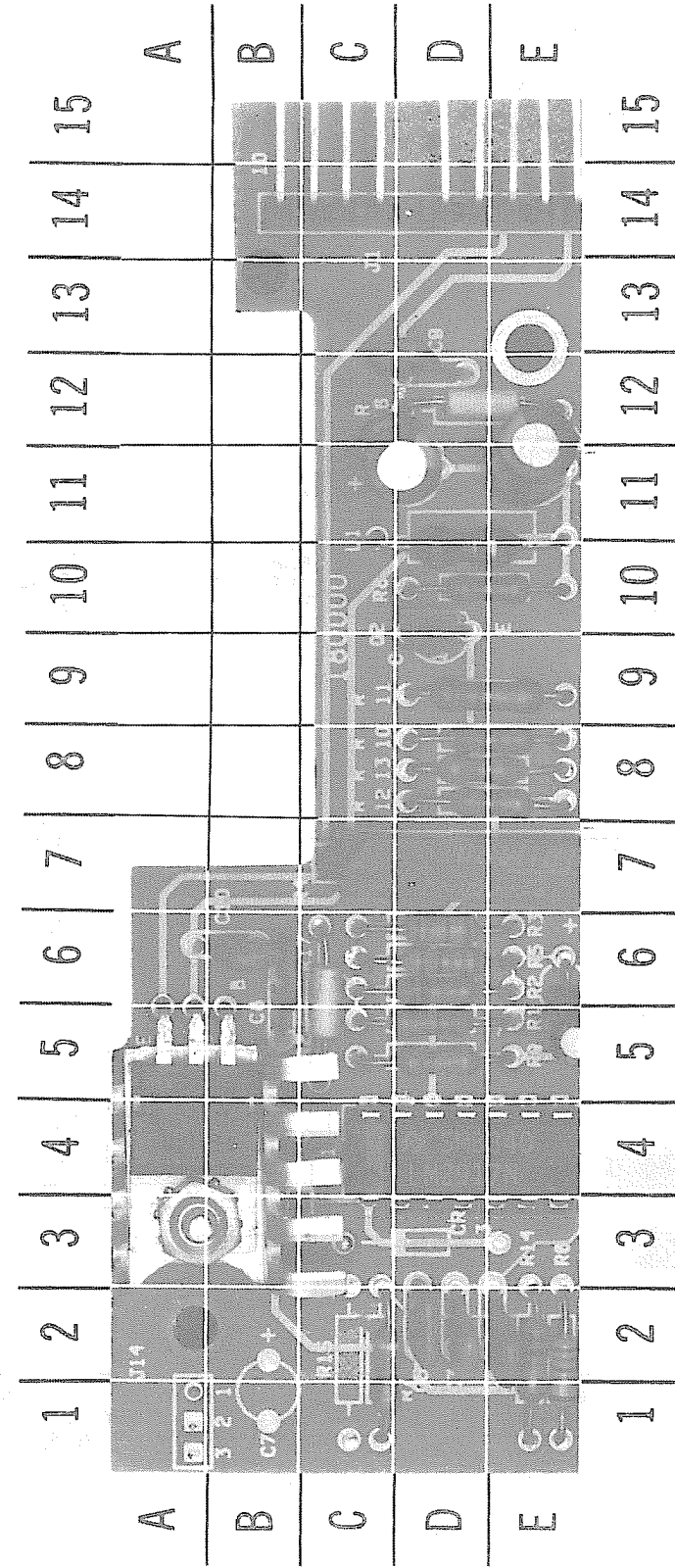


IBM
CSCS-2-C
MODEL 5150

DISK DRIVES (A & B) TYPE 1, SERVO BOARD



 INDICATES DISK DRIVE CHASSIS



SERVO BOARD GridTrace LOCATION GUIDE

GENOME BAND	START LOCATION (kb)	END LOCATION (kb)	CHROMOSOME
C1A	D-11	C6A	L1A
C2A	E-11	C8A	P20
C3A	D-2	C9A	P21
C4A	E-5	C10A	P1A
C5A	D-2	J1A	Q2A

D-10	R1A	D-5	R6A
C-14	R2A	D-6	R7A
D-14	R3A	D-6	R8A
A-4	R4A	E-7	R9A
D-10	R5A	D-6	R10A

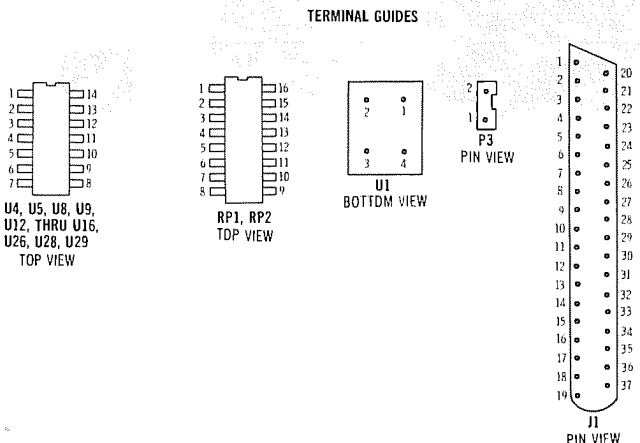
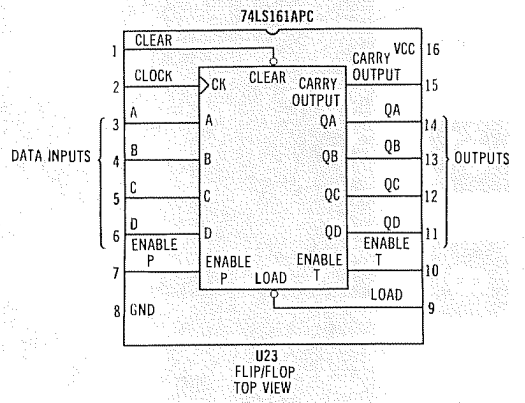
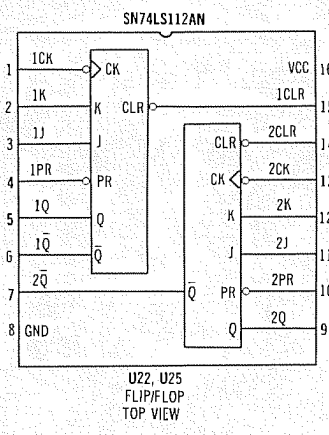
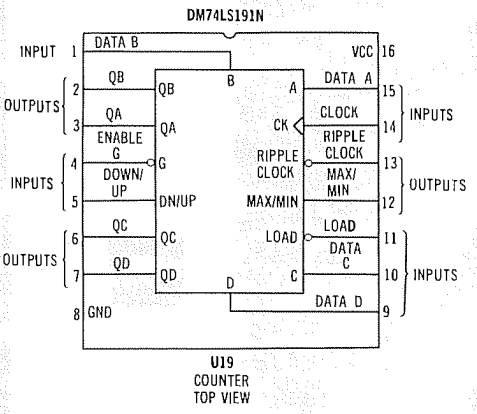
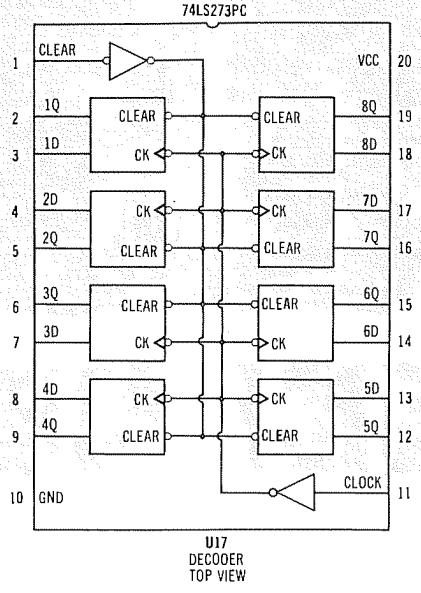
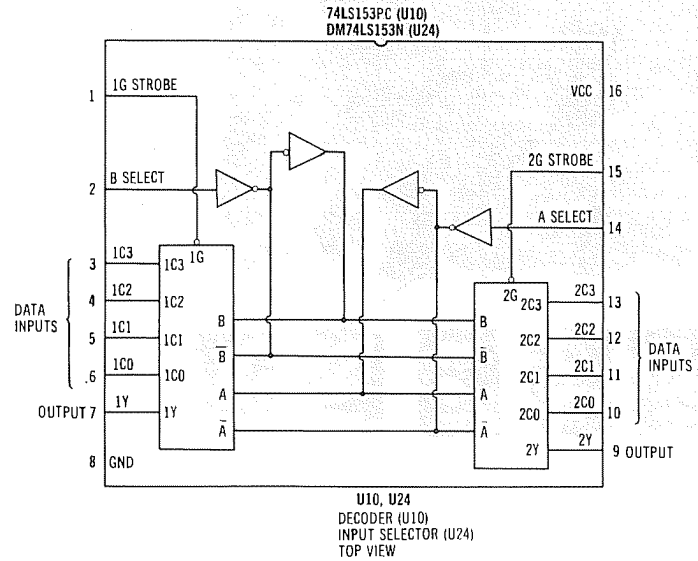
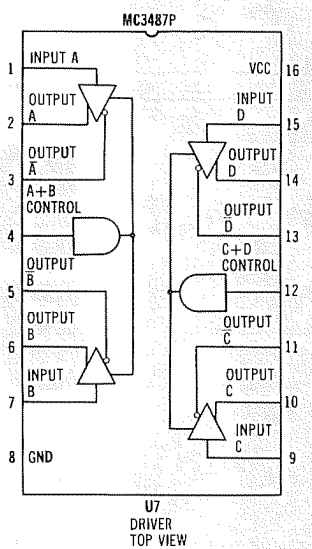
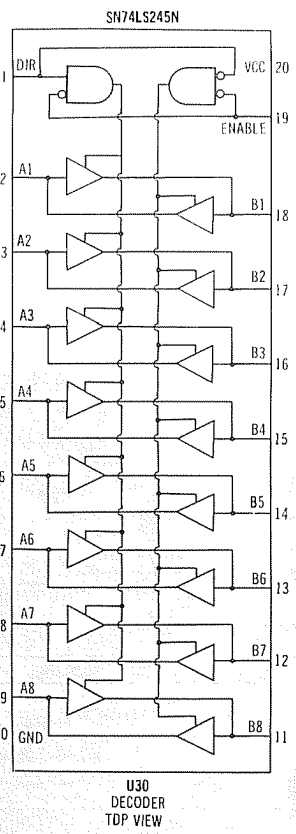
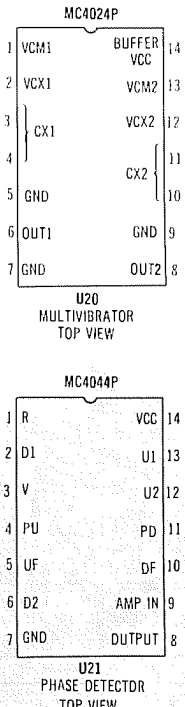
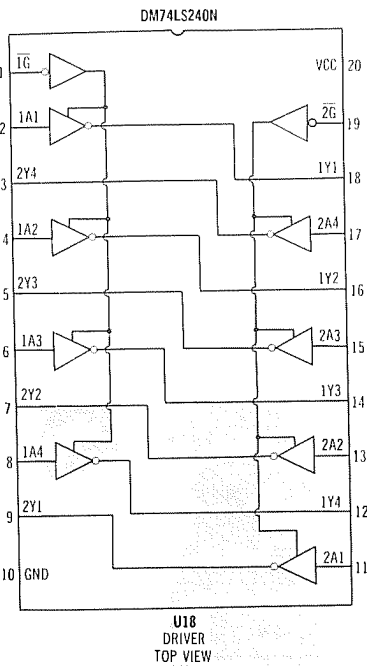
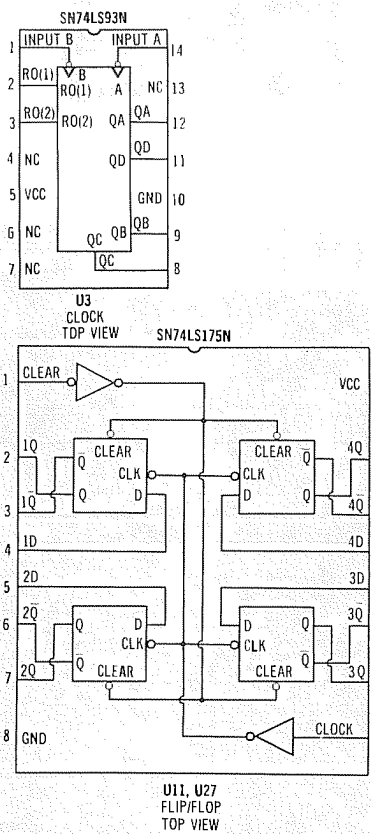
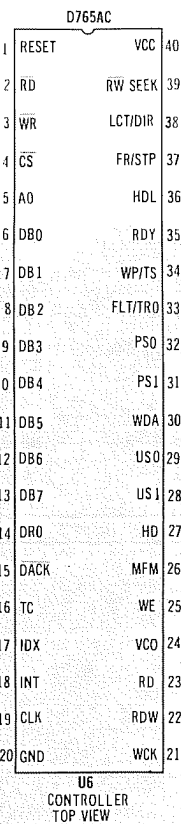
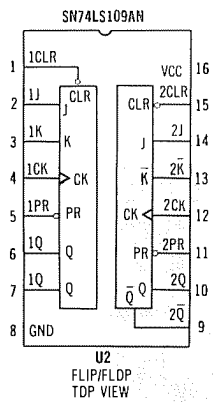
E-2	R11A
C-2	R12A
E-12	R13A
D-5	R14A
E-8	R17A

R18A

D-9
E-8
E-8
E-2
C-5

D-12

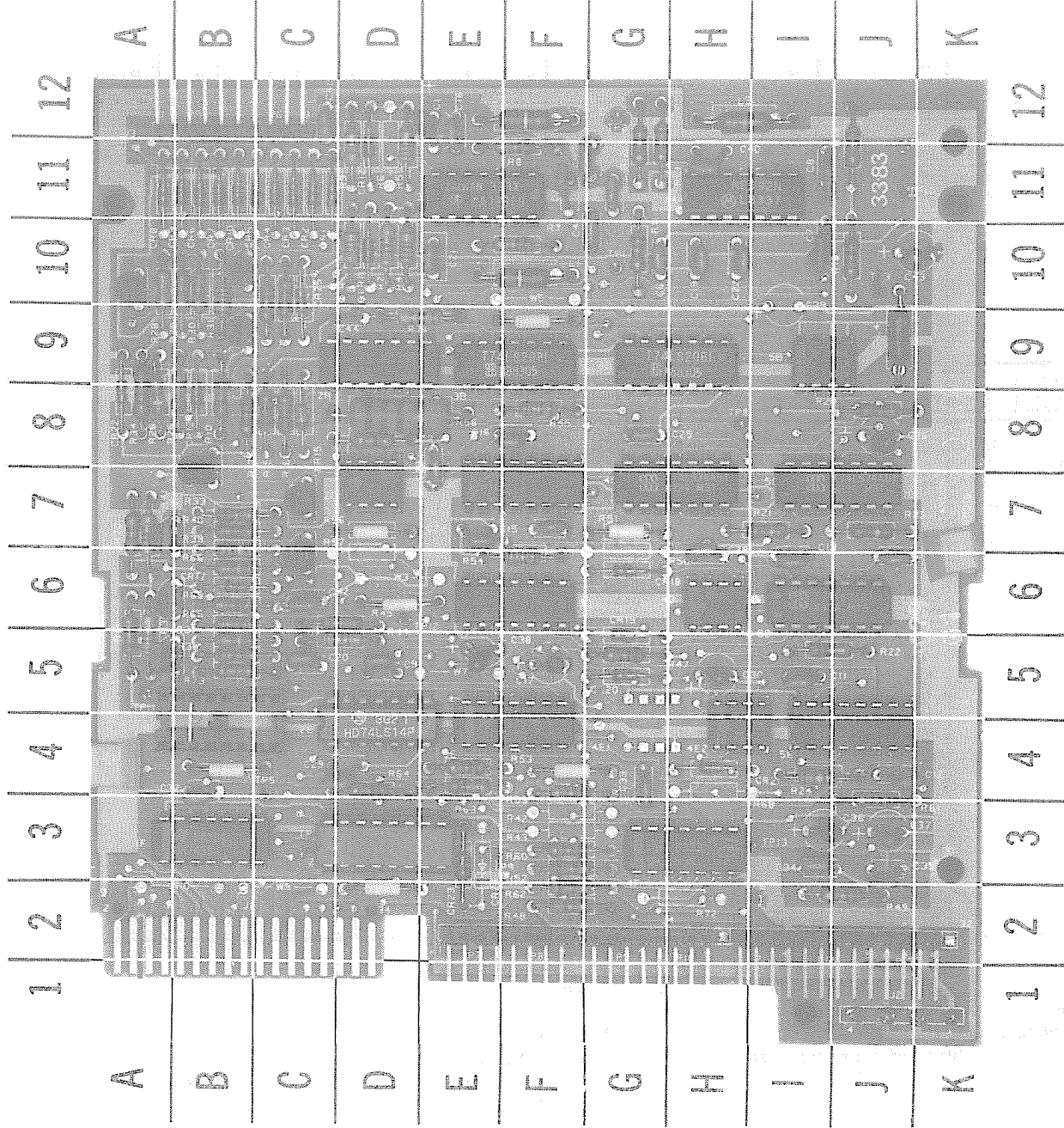
IC PINOUTS & TERMINAL GUIDES



CSCS2-C MODEL 5150 IBM

DISK DRIVES (A & B) TYPE 1 GridTrace LOCATION GUIDE

C1	E-12	C30	H-5	CR17	B-6	Q5	A-6	R23	J-7	R53	E-4	TP9	E-3
C2	F-11	C32	B-3	CR18	G-6	Q6	A-5	R24	I-4	R54	F-6	TP10	J-11
C3	G-11	C33	G-4	CR19	G-6	Q7	A-7	R25	B-8	R55	F-8	TP11	A-5
C4	F-10	C34	I-3	CR20	G-5	Q8	C-6	R26	A-8	R56	D-7	TP12	D-6
C5	F-11	C35	J-3	CR21	H-4	Q9	B-7	R27	C-10	R58	D-8	TP13	I-3
C6	G-10	C36	J-3	CR22	A-8	Q10	C-7	R28	A-10	R59	F-4	1F	B-3
C7	I-10	C37	J-3	CR23	E-3	R1	D-10	R29	B-10	R60	F-3	2B	D-9
C8	I-11	C38	E-5	CR25	R2	R3	D-10	R30	B-10	R61	J-3	2C	D-7
C9	D-5	C40	H-11	J1	B-2	R3	D-11	R31	B-10	R62	F-2	2E	D-4
C11	I-5	C41	C-12	J2	J-1	R4	D-10	R33	B-7	R63	E-4	3A	E-11
C12	J-4	C42	C-6	J3	B-12	R5	D-11	R34	A-8	R64	D-4	3B	F-9
C13	I-6	C43	J-10	J4	H-2	R7	F-10	R35	C-10	R65	B-6	3C	F-7
C14	J-6	C44	D-9	L1	F-10	R8	F-11	R36	B-5	R66	B-6	3D	F-6
C15	F-7	CR1	C-11	L2	F-12	R9	D-8	R37	B-5	R68	H-4	3E	F-4
C16	F-8	CR2	C-11	L3	H-12	R10	B-8	R38	A-7	R69	B-6	4A	H-11
C17	F-5	CR3	C-11	L4	C-4	R11	G-10	R39	B-6	R70	A-7	4B	G-9
C18	E-12	CR4	C-11	P5	B-12	R12	G-11	R40	B-7	R71	D-9	4C	G-7
C19	H-10	CR5	B-11	P6	C-12	R13	G-11	R41	A-7	R72	H-2	4D	H-6
C20	C-5	CR6	B-11	P8	F-2	R14	A-5	R42	F-3	R73	B-5	4E2	H-4
C21	E-10	CR7	B-11	P9	G-2	R15	C-8	R43	F-3	TP1	G-10	4F	H-3
C22	H-10	CR8	A-11	P10	H-2	R16	C-8	R44	D-5	TP2	G-12	5B	I-9
C23	E-7	CR9	B-11	P11	I-2	R17	B-8	R45	D-6	TP3	J-10	5C	I-8
C25	G-8	CR10	B-11	P12	I-2	R18	J-10	R47	G-5	TP4	J-11	5D	I-6
C26	J-8	CR11	D-10	P13	J-2	R19	J-11	R48	F-2	TP5	C-4	5E	I-4
C27	C-7	CR12	D-11	Q1	A-10	R20	J-8	R49	J-2	TP6	I-2		
C28	H-6	CR13	B-8	Q2	B-10	R21	I-7	R51	G-7	TP7	C-3		
C29	C-4	CR15	C-8	Q3	B-9	R22	J-5	R52	F-3	TP8	H-8		

A Howard W. Sams **GRIDTRACE™** Photo

DISK DRIVES (A & B) TYPE 1

CSCS2-C
IBM
MODEL 5150

DISK DRIVE ADAPTER LOGIC

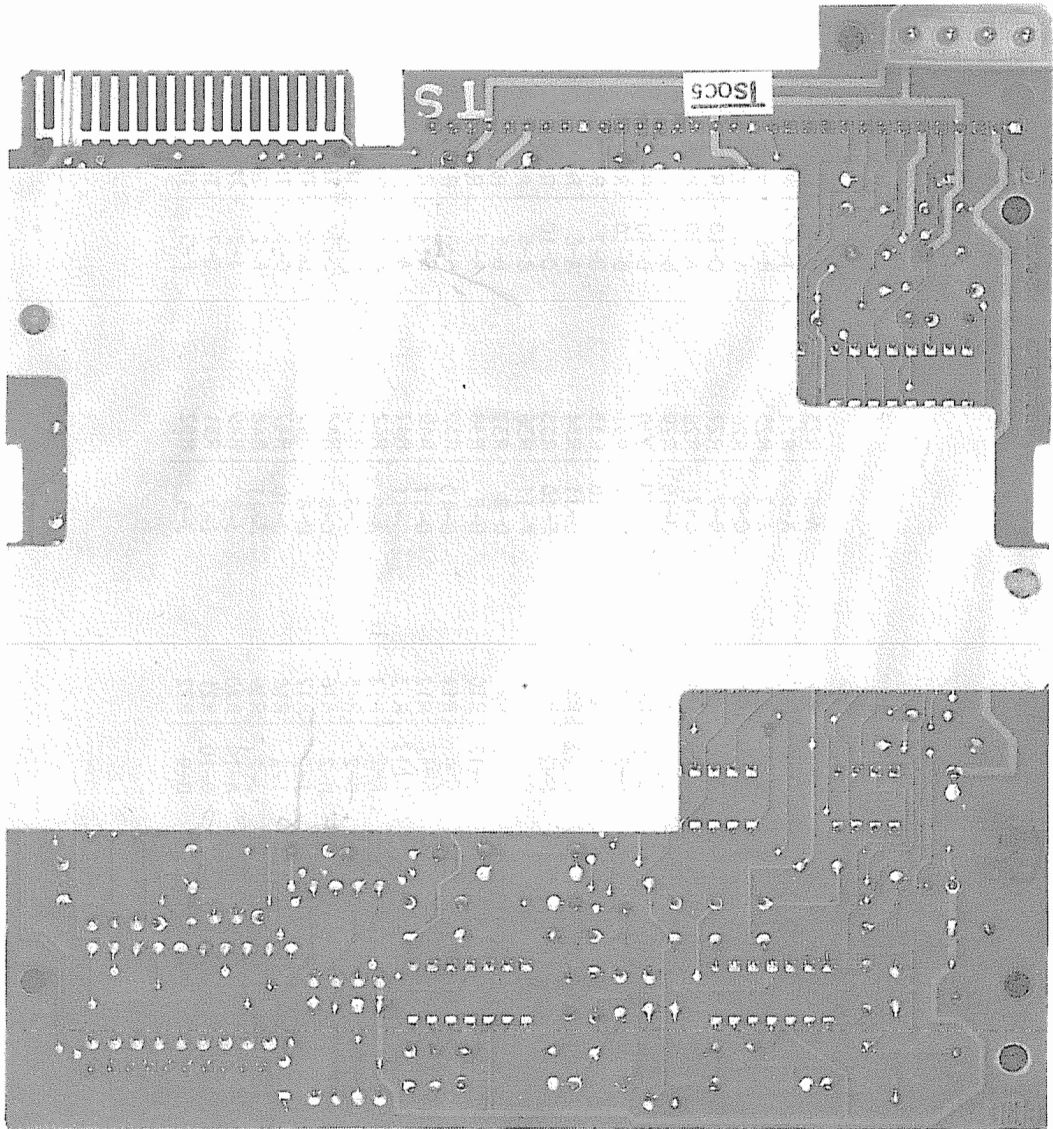
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1	H	P	L(3)	*	1	L	21	P	1	P	L(4)	P	L	P	L
2	H	*	L(2)	*	2	P	22	P	2	P	L(4)	P	P	P	H
3	L	L	L(2)	H	3	P	23	P	3	P	*(2)	P	L(4)	P	L
4	P	*	P	*	4	P	24	P	4	H	P	L(4)	L(4)	P	H
5	H	H	P	*	5	P	25	P	5	P	P	L(4)	L(4)	P	H
6	P	*	P	H	6	P	26	H	6	P	P	H(5)	L(4)	P	L
7	P	*	L	L	7	P	27	P	7	P	P	L	L(4)	P	L
8	L	P	L(2)	H	8	P	28	L(2)	8	L	P	H(2)	L	L	P
9	P	P	P	*	9	P	29	H(2)	9	P	P	L(2)	P	P	P
10	P	L	L(2)	*	10	P	30	P	10	P	P	L(2)	P	P	P
11	H	P	H	P	11	P	31	P	11	P	*(2)	P	P	P	P
12	P	P	*	H	12	P	32	P	12	*	L(2)	P	P	P	P
13	L	*	*	P	13	P	33	L(2)	13	P	L(2)	P	L	P	P
14	P	P	H	H	14	P	34	L	14	P	H	H	L	P	H
15	P				15	P	35	H	15	P			L	P	
16	H				16	P	36	H(2)	16	H			H	H	
					17	P	37	P							
					18	P	38	L(4)							
					19	P	39	L(2)							
					20	L	40	H							

PIN NO.	IC U13	IC U14	IC U15	IC U16	IC U17	IC U18	IC U19	IC U20	IC U21	IC U22	IC U23	IC U24	IC U25	IC U26	IC U27
1	P	L	L	L	H	L	*	H	P	P	H	L	P	L	P
2	P	L	L	L	H	P	P	H	P	P	P	P	P	*	P
3	P	L	*	H	P	P	P	H	P	P	*	P	P	*	P
4	P	P	L	H	P	H	L	H	P	P	*	P	H	P	P
5	P	P	L	H	L	L	H	L	P	P	*	P	P	P	P
6	P	P	*	L	H	H(1)	P	P	P	P	*	P	P	P	P
7	L	L	L	L	P	L(3)	P	L	L	L	H	L	L	L	L
8	H	P	*	L	P	P	L	H	H	L	L	L	L	*	L
9	P	P	L	H	H	P	*	L	*	P	H	P	P	*	P
10	P	P	L	H	L	L	*	*	P	H	H	P	P	L	P
11	P	H	L	H	L	P	H	*	P	P	P	P	P	*	P
12	P	H	L	L	L	P	P	*	P	H	P	P	P	*	P
13	P	H	L	L	P	H	P	*	P	P	P	P	P	L	P
14	H	H	H	H	P	L(3)	P	H	H	H	P	L	H	H	P
15					H	H	*				P	H	H		P
16					L	L	H				P	L	H		P
17					P	H					H	H			H
18					P	P									
19					L	H									
20					H	H									

NOTE: Logic probe readings taken on Disk Drive B while running the following Basic program. Readings taken while the Head Position Motor (M2) is not operating unless otherwise noted. A diskette formatted for doubled sided use was used. Diskette was not write protected. Disk Drive A and B have the same voltages, logic probe readings and waveforms unless otherwise noted.

```
10 OPEN "B:SAMS.DAT" FOR OUTPUT AS #1
20 FOR X = 1 TO 300
30 PRINT #1, "THIS IS A TEST"
40 NEXT X
50 CLOSE #1
60 GOTO 10
```

- Logic Probe Display
L = Low
H = High
P = Pulse
* = Open (No light On)
- (1) Probe indicates L when Head is on track 00 and H when off track 00.
 - (2) Probe Indicates P when Head Position Motor is operating.
 - (3) Probe indicates H when Head is on track 00 and L when off track 00.
 - (4) Probe Indicates H when Head is moving in and L when Head is moving out from center of diskette.
 - (5) Probe indicates L when Head is moving in and H when Head is moving out from center of diskette.



IBM
MODEL 5150

DISK DRIVES (A & B) TYPE 1—SHIELD LOCATION

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

COILS (RF-IF)

ITEM No.	FUNCTION	MFR. PART No.	ITEM No.	FUNCTION	MFR. PART No.
DISK DRIVES (A & B) TYPE 1			L2	Peaking (390uH)	
L1	Peaking (390uH)		L3	Peaking (680uH)	
L1A	RF Choke		L4	RF Choke	

MISCELLANEOUS

ITEM No.	PART NAME	MFR. PART No.	NOTES
DISK DRIVE ADAPTER			
U1	Crystal Adapter	8529152	16MHz 5 1/4" Disk Drive
DISK DRIVES (A & B) TYPE 1			
CR26	LED	8529257(1)	Index/Selector (Includes Q11)
CR27	LED	8529258	Activity, Red
HEAD 0	Head		R/W, E
HEAD 1	Head		R/W, E
M1	Assembly	8529223	Motor/Generator
M2	Motor		Head Position
SW1	Switch	8529225	Write Protect
SW2	Switch	8529224(1)	Track 0
	Arm	8529265(1)	SSR Upper
	Assembly	8529267	Cone Lever
	Assembly	8529153	Disk Drive (160K)
	Assembly	8529206	Disk Drive (320K)
	Assembly	8529263	Spindle
	Belt	8529154	Disk Drive
	Cone	8529259	
	Guide	8529262	Left
	Guide	8529261	Right
	Module	8529264(1)	SSR (160K)
	Module	8529210(1)	DSR (320K)
	P.C. Board	8529226	Disk Drive
	P.C. Board	8529256	Servo
	Stop	8529266(1)	Track 0

(1) Restricted Availability.

Part Numbers obtained from the IBM
Hardware Maintenance and Service Manual
(Part Number 6025072)
Courtesy of IBM

CABINET & CABINET PARTS (When ordering specify model, chassis & color)

ITEM	PART No.	ITEM	PART No.
DISK DRIVES (A & B) TYPE 1		Latch Assembly	8529260
Front Panel	8529293		

Part Numbers obtained from the IBM
Hardware Maintenance and Service Manual
(Part Number 6025072)
Courtesy of IBM

DISK DRIVE
ADAPTER
LOGIC (Continued)

PIN NO.	IC U28	IC U29	IC U30
1	P	L	P
2	P	H	P
3	P	L	P
4	P	L	P
5	P	H	P
6	P	H	P
7	L	L	P
8	P	L	P
9	*	P	P
10	*	P	L
11	P	*	P
12	P	*	P
13	*	L	P
14	H	H	P
15			P
16			P
17			P
18			P
19			L
20			H

SERVO
BOARD
LOGIC

PIN NO.	IC U1
1	(8)
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	

DISK DRIVES
(A & B) TYPE 1
LOGIC

PIN NO.	IC 1F	IC 2B	IC 2C	IC 2E
1	P	P	*	P
2	H	P	*	P
3	P	P	*	P
4	L(6)	P	L	L
5	H	P	P	P
6	H	P	P	P
7	L	L	P	L
8	P	L	H	P
9	P	P		P
10	H	P		L(2)
11	H(1)	P		H(2)
12	L(3)	L		P
13	H	H		P
14	H	H		H

PIN NO.	IC 3A	IC 3B	IC 3C	IC 3D	IC 3E	IC 4A	IC 4B	IC 4C	IC 4D	IC 4E2	IC 4F	IC 5B	IC 5C	IC 5D	IC 5E
1	(8)	P	P	H(1)	*	(8)	H	H	H	H	L(3)	L	H	H(5)	L
2		P	P	L(3)	*(2)		P	H(5)	L(2)	H(5)	L(3)	(8)	P	L(4)	P
3		*	H	L(4)	L		*	H(2)	L(2)	H(1)	(8)	P	H(5)	L(4)	H
4		H	P	H(5)	L		H(4)	H	L	L	H	L	H	L(4)	P
5		H	P	H(5)	H		L(2)	L(2)	L(2)	H(5)	L	(8)	P	L(2)	P
6		P	*	L(4)	H		H(2)	H(2)	H(2)	L(4)	H	(8)	P	L(2)	P
7		L	*	L	L		L	L	H	H	L	P	L	L	P
8		P	L	H	L		H(1)	H(5)	H	H	H(4)	(8)	P	L	L
9		H	P	L	L		L(3)	L(4)			H(5)		P	P	L
10		H(7)	H	H(7)	P		H(5)	H			L(3)		P	P	P
11		*	H	L(6)	P		*	H(2)			L(3)		P	P	P
12		H	P	P	P		H(2)	L(2)			H(1)		P	P	P
13		P	P	P	P		L(3)	H			H(1)		P	P	P
14		H	*	H	H		H	H			H		H	H	P
15			*												P
16			H												H

NOTE: Logic probe readings taken on Disk Drive B while running the following Basic program. Readings taken while the Head Position Motor (M2) is not operating unless otherwise noted. A diskette formatted for doubled sided use was used. Diskette was not write protected. Disk Drive A and B have the same voltages, logic probe readings and waveforms unless otherwise noted.

10 OPEN "B:SAMS.DAT" FOR OUTPUT AS #1
20 FOR X= 1 TO 300
30 PRINT #1, "THIS IS A TEST"
40 NEXT X
50 CLOSE #1
60 GOTO 10

Logic Probe Display
L = Low

H = High

P = Pulse

* = Open (No light On)

- Probe indicates L when Head is on track 00 and H when off track 00.
- Probe indicates P when Head Position Motor is operating.
- Probe indicates H when Head is on track 00 and L when off track 00.
- Probe indicates H when Head is moving in and L when Head is moving out from center of diskette.
- Probe indicates L when Head is moving in and H when Head is moving out from center of diskette.
- Probe indicates H if diskette is write protected.
- Probe indicates L if diskette is write protected.
- Probe reading not taken for IC U1 on Servo Board and ICs 3A, 4A and pins 2, 3, 5, 6 and 8 of 5B on Disk Drive Board.

CSCS2-C
MODEL 5150
IBM

PARTS LIST AND DESCRIPTION

When ordering parts, state Model, Part Number, and Description

SEMICONDUCTORS

ITEM No.	TYPE No.	MFGR. PART No.
DISK DRIVE ADAPTER		
D1 ,D2		
U2	SN74LS109AN	
U3	SN74LS93N	
U4	74LS08PC	
U5	DM74LS08N	
U6	D765AC	
	UPD765	
U7	MC3487P	
	MC3487	
U8 ,9	DM7438N	
U10	74LS153PC	
U11	SN74LS175N	
U12	74LS04PC	
U13	SN74LS32N	
U14	SN74LS08N	
U15	DM7438N	
	7438-3	
U16	DM7438N	
	7438-4	
U17	74LS273PC	
U18	DM74LS240N	
U19	DM74LS191N	
U20	MC4024P	
	MC4024	
U21	MC4044P	
	MC4044	
U22	SN74LS112AN	
U23	74LS161APC	
U24	DM74LS153N	
U25	SN74LS112AN	
U26	SN74LS02N	
U27	SN74LS175N	
U28	SN74LS30N	
U29	SN74LS02N	
U30	SN74LS245N	
DISK DRIVES (A & B) TYPE 1		
CR1	1N4446	
thru		
CR14		
CR15	1N5226C	
CR15A	1N4446	
CR16	1N4446	
thru		
CR21		

ELECTROLYTIC CAPACITORS

Item numbers not listed are normally available at local distributors.

ITEM No.	RATING	MFGR. PART No.
DISK DRIVE ADAPTER		
C18	10 16V 10% (1)	

(1) 8.2 used in some versions.

ITEM No.	TYPE No.	MFGR. PART No.
CR22	1N5234B	
CR23	1N4003	
CR25	1N5230	
Q1	2N4124	
Q1A	T1P110	
Q2	2N4124	
Q2A	2N4124	
Q3 ,4	2N4124	
Q5	2N4125	
thru		
Q7		
Q8	2N4124	
Q9	2N4403	
Q10	2N4124	
Q11	GE1 .14CX511	
U1	LM2917N	
1F	SN7438N	
	DM7438N	
2B	7406N	
2C	SN75463P	
	DS75463N	
2E	HD74LS14P	
3A	UA733CN	
3B	T74LS20B1	
3C	74123N	
	DM74123N	
3D	7404N	
3E	DM7407N	
4A	NE592N14	
	NE592N	
4B	T74LS20B1	
4C	HD74LS74AP	
	T74LS74AB1	
4D	DS75462N	
4E2	DS75462N	
4F	SN7438N	
	DM7400N	
5B	LM311P	
	LM311M	
5C	HD74LS74AP	
	T74LS74AB1	
5D	HD74LS86P	
	T74LS86B1	
5E	74221N	

ITEM No.	RATING	MFGR. PART No.
C19	10 16V 10% (1)	

PARTS LIST AND DESCRIPTION (Continued)

When ordering parts, state Model, Part Number, and Description

CAPACITORS Item numbers not listed are normally available at local distributors.

ITEM No.	RATING	MFGR. PART No.
DISK DRIVE ADAPTER		
C11A	82 ±.25pF	

ITEM No.	RATING	MFGR. PART No.
C21	68 NPO	

CONTROLS (All wattages ½ watt, or less, unless listed)

ITEM NO.	FUNCTION	RESISTANCE	MFGR. PART NO.	NOTES
DISK DRIVES (A & B) TYPE 1				
R4A	Speed Adj	1000	3006-1-102(1)	

(1) Number on unit.

RESISTORS (Power and Special)

ITEM No.	RATING	REPLACEMENT DATA	
		MFGR. PART No.	NOTES
DISK DRIVE ADAPTER		316E221331 Q5180287 (2) 898-1-R2K (2)	
R2	2150 1% 1/4W Carbon Film 3300 5% 1/4W Carbon Film		
R4	2000 1% 1/4W Carbon Film		
R5	2000 1% 1/4W Carbon Film		
RP1	Resistor Network (1)		
RP2	Resistor Network (3)		
DISK DRIVES (A & B) TYPE 1			
R1	4750 1% 1/4W Carbon 8200 5% 1/4W		
R3	4750 1% 1/4W Carbon 8200 5% 1/4W		
R3A	1540 1% 1/4W Carbon Film 1000 1% 1/4W Carbon Film		
R4	15K 1% 1/4W Carbon Film 27K 5% 1/4W Carbon Film		
R5	15K 1% 1/4W Carbon Film 27K 5% 1/4W Carbon Film		
R5A	2670 1% 1/4W Carbon Film 1000 1% 1/4W Carbon Film		
R6A	150K 1% 1/4W Carbon Film		
R24	3090 1% 1/4W Carbon Film		
R25	750 5% 1/4W Carbon Film 768 1% 1/4W Carbon Film		
R31	1000 1% 1/4W Carbon Film 768 1% 1/4W Carbon Film		
R34	270 5% 1/4W Carbon Film 1540 1% 1/4W Carbon Film		
R35	750 5% 1/4W Carbon Film 768 1% 1/4W Carbon Film		
R54	13.3K 1% 1/4W Carbon Film		
R55	28.7K 1% 1/4W Carbon Film		
2F	Resistor Network (4)		

- (1) Contains fourteen 330 and 220.
- (2) Number on unit.
- (3) Contains fifteen 2000.
- (4) Contains eight 150, used in drive A only.